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## The Two New Record-Breaking Steamships for the White Star Line.

At the great shipyards of Harland & Wolff, at Belfast, Ireland, the keels have just been laid for two steamships which will exceed in size even the two huge Cunarders which were put in service a year ago. These two new vessels are being built for the White Star Line, and are to be named the "Titanic" and "Olympic." The exact length and breadth are not yet made public, but they are to be approximately, about 900 ft. long with a beam of about 90 ft.

In preparation for the construction of these monster vessels, a huge overhead crane system has been built at the shipyards, and is shown in the accompanying cut. This structure spans the two berths in which the vessels are to be built up. It is about 200 ft. in total height, 1,000 ft. in length and over 200 ft. in width. It is equipped with 29 electric traveling cranes with capacities for from five to forty tons. A special foundation has been made to support the huge vessels, and it is stated that some ten thousand piles have been driven and capped with a platform of reinforced concrete.

OVERHEAD CRANE STRUCTURE IN THE SHIPYARDS OF HARLAND & WOLFF, BELFAST, IRELAND, TO BE USED IN CONSTRUCTION OF THE WHITE STAR STEAMERS "TITANIC" AND "OLYMPIC."

While the new vessels are to exceed in length and beam the Cunard greyhounds "Mauretania" and "Lusitania," they are not to attempt to compete with them in speed. The speed now proposed is about 20 knots, and the space occupied by the engines and boilers and fuel, therefore, will not be so great but that the ships can carry large cargoes of freight. Speed is not in such high demand, of course, that more than a small number of highest-speed ships would pay. The large cargoes of fast freight are the real income producers.

The inherent value of great size, however, at least for regular line vessels, has been thoroughly demonstrated. Not only do the sea leviathans possess superior riding qualities, but great size facilitates the employment of safety devices in construction and equipment.

## A Crucial Practical Test of the High-Pressure Fire Service in Manhattan Borough, New York City.*

The high-pressure fire system in New York, which was put officially into service on July 6, 1908, has been successfully operated since that date at 115 fires, but it had its crucial test, and one to which it will not probably be subjected again in years, on Jan. 7, 8 and 9, 1909, when it was brought into service for five simultaneous fires, three of them of much more than the usual extent and activity, and one particularly so.

These fires occurred at Hudson and Franklin streets, Hester St. and the Bowery, Houston St. and Broadway, Sixth Ave. and 17th St., and Houston St. and the Bowery. The situation became so dangerous that every engine south of 37th St., i. e., 40 engines, were summoned, as well as a force consisting of twelve battalion chiefs and more than 600 men, but there was no need to use a single one of the fire engines.

*A statement furnished by the courtesy of Mr. I. M. De Varona, Chief Engineer, Department Water Supply, Gas and Electricity, New York City.

The fire at Franklin and Hudson streets was particularly severe and was described by Chief Croker as a "3-9" fire. But even in that case, the extraordinarily effective work of the high-pressure fire streams prevented the spread of the flames beyond the building in which the fire originated, and successfully extinguished it—a result which the Chief of the Fire Department declared could never have been accomplished with the old system. The result was the same at the four other fires.

The area of buildings, number of alarms and time of service were as follows:

At Hudson and Franklin streets, where the largest fire occurred, the area of the building affected was 13,400 sq. ft. For this fire four alarms were received, the first one at 7.22 p. m. on Jan. 7, and the service was shut down at 10.34 a. m. on Jan. 9.

At Hester St. and Bowery, the area of building affected was 3,600 sq. ft. Three alarms were received, the first one at 7.52 p. m., Jan. 7.

At Houston St. and Broadway, the area of the building affected was 9,800 sq. ft. Five alarms were received, the first one at 8.30 p. m., Jan. 7.

The fires at Sixth Ave. and 17th St. and at Houston St. and the Bowery were one-alarm fires, received at 11.11 p. m., Jan 7 and 2.14 a. m., Jan. 8, respectively.

As the violence of the fires increased, additional pumps were brought into service, so that at one time four pumps and motors were in commission at the Oliver and South St. station and three pumps at the Gansevoort and West St. station, delivering 33,500 gals. per min. against an average pressure of 225 lbs. at the pumps and 205 lbs. at the hydrants. During the operation of the pumps, 14,095,000 gals. were pumped, as recorded by the Venturi meters, and the current used was 81,450 KW. hours, the cost of which was $1,222.

The extraordinarily large amount of water pumped—which does not represent the total quantity, because, at the early stages with a

small draft, the Venturi meters do not register—will attract attention. At least a portion of this water probably represents unnecessary waste, due, as in previous cases, to the fact that the high-pressure fire service was kept in operation long after the fire had been extinguished, in order to "wet down" the smoldering fire within the debris, which could just as well be done by attaching hose to the low-pressure fire hydrants, thus saving water, current and labor. With further experience better results in this respect are to be expected.

## A Reinforced-Concrete Theater and Office Building, Los Angeles, Cal.

The Majestic Theater and Office Building at Los Angeles, Cal., consists of a full-sized two-balcony theater, in front of and over which is an eight-story and basement office building, all built of reinforced concrete. In fact, the only material beside concrete used in the structural part of the building is a steel paint bridge over the stage. In general design it follows the usual column, beam and floor-slab standards, but in the cantilever balconies and roof beams over the auditorium, the extraordinary size of the members make them worthy of record. The walls are for the larger part of concrete, covered on the outside with tile to the first story and with brick above. Inside the concrete faces are covered with plaster, decorated in accordance with the style of the building.

The general layout of the building is shown in Figs. 1 and 2. As noted on the plan (Fig. 2) the stage proper occupies the full width of the lot, 79 ft., but to comply with the building regulations a 6-ft. alleyway is provided on either side of the auditorium and office building leading from the street to the stage, so that the front of the building is only 67 ft. in width. Into this alley fireproof exits lead by way of concrete staircases. We will not enter into the decoration or structural description of the theater and office building as a whole, but will present a description of the peculiar heavy construction, prepared by Messrs. Mayberry and Parker, the designers and supervisors of the concrete work. This description follows:

BALCONY CANTILEVERS.—The longest cantilevers of the gallery and balcony are 27 ft. and 30 ft. projection, respectively; that is, both of them have the greatest projection of any known reinforced-concrete cantilever, while that of the balcony has an equal projection with the longest known steel cantilevers of similar construction. These statements, of course, do not include bridge construction. The balcony is supported by six of these reinforced-concrete cantilevers (Fig. 2), giving it a free overhang of 30 ft. The two side cantilevers are brackets 18 ft. long, coming off of the truss columns on either side of the auditorium. The four great central cantilevers, two of which are 45 ft. long, and two 51 ft. long, have a clear projection of 29 and 30 ft., respectively, and are supported on independent columns which are located in the curtain wall between the main floor of the auditorium and the foyer. The cantilevers rest on these columns, extend back over the foyer and are anchored in the reinforced-concrete wall six stories high at the rear of the auditorium. (Fig. 3.) These cantilevers vary in section from 10 ins. wide to 12 ins. deep at the outer end to 18 ins. wide by 78 ins. deep at the maximum section over the column support and are reinforced with seven 1⅝-in. square twisted steel bars on the tension side, extending through the anchor-arm into the rear wall. There are three 1-in. square twisted bars on the compression side. It will be seen by the figure that as the moment decreases and there is a corresponding excess of steel on the tension side, the bars are bent down and hooked under the compression steel. This method of disposing of the tension steel assisted the stirrups in binding the two groups of steel together, at the same time resisting so-called shearing stresses (tension on the 45° plane) directly in an admirable manner.

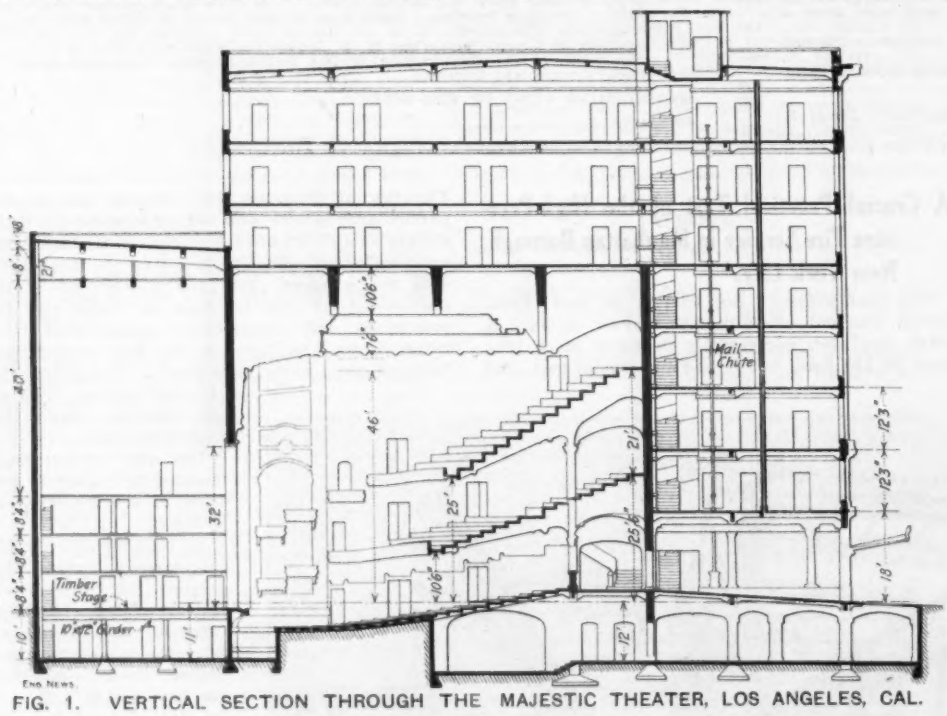


FIG. 1. VERTICAL SECTION THROUGH THE MAJESTIC THEATER, LOS ANGELES, CAL.

That portion of the balcony between the cantilever is constructed similar to the ordinary joist system. The risers are reinforced-concrete joists, or beams, resting on the cantilevers and monolithic with them, while the slab is supported on the top of one riser and hung from the bottom of the next. This construction is very economical in reinforced concrete for, unlike with other materials, these beams are cast to conform to the curve of the balcony seats, a feature that could not be carried out in structural steel except at a considerable increase in cost. The gallery is constructed in the same manner, but of three feet less projection, having an extreme overhang of 27 ft. The column supports center on, and are continuous with those of the balcony beneath.

Both the balcony and gallery were designed to sustain a superimposed load of 125 lbs. per sq. ft. (with 20,000 lbs. per sq. in. in the steel and 500 lbs. per sq. in. in the concrete), and have been tested to over double that load. In making these tests the cantilever arm, only, was loaded, no load being placed on the anchor arm, this, of course, was the worst possible condition and made the tests extremely severe ones. A superimposed load of 95,600 lbs., a little over 260 lbs. per sq. ft., was placed on one panel in the balcony between two cantilevers and extending from the supporting columns to the front rail, an area of 361 sq. ft. This was a severe test on the floor construction, at the same time was more than equivalent to the load for which the cantilevers were designed, and as will be shown below, was over 2½ times the maximum load they will ever be called upon to sustain. Under the above load the deflection at the end of the 30-ft. cantilevers was only ¼-in. On the gallery a load of [illegible] lbs., a trifle more than 270 lbs. per sq. ft., was placed directly over one cantilever, extending from center of adjoined panels, and as before from the column supports to the front rail of the gallery, an area of [illegible] ft. The deflection at the end of the cantilever 26 [illegible] long was only 3-16-in. Allowing 150 lbs. for the average weight per person of an audience and 50 lbs. for the weight of the opera chair and accessories, gives a total of 200 lbs. The space allowed to an opera chair is 3.75 [illegible] ft., exclusive of aisles. This gives a maximum possible load of 50 lbs. per sq. ft. with every chair filled and making no deductions for aisles.

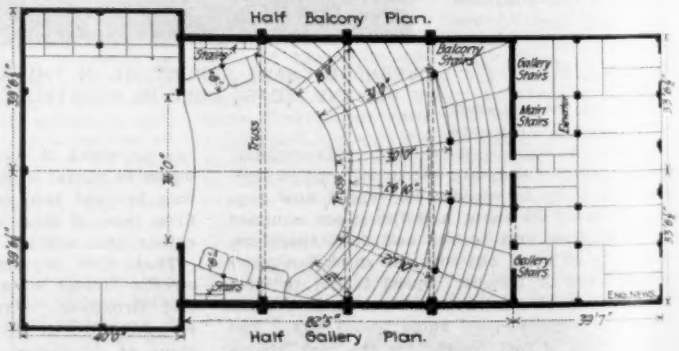


FIG. 2. PLAN OF MAJESTIC THEATER.

On either side of the proscenium arch, which is also reinforced concrete, are the boxes in two tiers and no boxes are on the same level, but are so arranged that the top of the rail of the farther box is on a level with the head of the occupants of the box nearer the stage. These boxes project from the wall 6 ft., and are carried by a 6-in. cantilever slab. It is interesting to note that the complicated structure around the boxes, consisting, not only of the boxes and rails at different levels, but also partition walls, several flights of stairs and the main walls of the building were all cast at the same time, truly a monolithic structure.

ROOF BEAMS.—The spanning of the auditorium with three great reinforced-concrete beams was a rather bold but successfully solved engineering problem. There are beams of longer span than these, notably those in the Temple Auditorium in the same city, which are, however, more truly arched trusses and support only a roof. The beams in the Majestic Theater have horizontal chords and carry a three-story building on them. They are 71 ft. long over all, 10 ft. deep, 24 ins. wide at top, 18 ins. wide at the bottom and are calculated to support a live and dead load of over 750,000 lbs., or 375 tons, with the same stresses noted above for the balcony cantilevers. They are reinforced, in the top chord, with twelve 1¾-in. square twisted steel bars, while there are fifteen 1¾-in. square twisted steel bars in the bottom chord. The top bars are bent down and used as shear bars, near the supports, passing to and down the outside of the supporting columns, forming and giving a strong portal action. The lower bars are brought up as required in successive stages to the top of the truss to care for the reversed stresses that occur at the supports in reinforced-concrete work. These bars were all hooked around bars at their ends. Owing to the great span it would be difficult to secure, as well as impracticable to use, continuous steel of such lengths, so it was necessary to use splices and these were located at points of less stress, and of from 5 to 6 ft. lap, with three clamps each. Even then steel 50 and 54 ft. long was required. It will be seen, by reference to Fig. 5, that in the corbels, where there would be maximum compression, owing to the reversal of stress as above, that the steel is arranged and laced in column form, following the line of the corbel. For the purpose of reducing the dead weight the central panels were reduced in thickness to 12 ins. These trusses could have been designed and built with open panels, but the cost of form work and difficulty of properly filling the separate members would more than offset the cost of extra concrete used. Moreover, the solid web assisted in caring for shearing stresses.

The shoring was not removed until the expiration of six weeks. Before striking the centering a level was set on each truss in succession to observe any deflection that might occur. Despite the fact that there was a load of 500,000 lbs. on each truss, the entire structure completed, when the centering was struck the mark never left the cross wires of the instrument. Afterwards an additional load of 250,000 lbs. was placed on one truss with a deflection of less than 1-64-in.

Supporting these great trusses are massive columns over 80 ft. long. The cross-section at the bottom of the trusses is 36 x 60 ins. and there are sixteen 1½-in. square twisted steel bars on the outer or tension side and twelve 1½-in. square twisted steel bars on the inside. The steel varies from 12 to 37 ft. long and, with the exception of the shear bars which extend down to the

balcony level, this column steel is carried down into the footings. The bars are arranged in lengths, so that not more than one-quarter of the steel laps at the same section, and these laps are mostly 4 ft. long, with three clamps to each lap. As shown on the drawings these columns project 2 ft. on the outside of the auditorium walls, as pilasters. This was done to give an increased section for moment and at the same time not encroach on the theatre space farther. These pilasters, of course, extended into the 6-ft. alleyways required by city ordinance, and in order to preserve the same it was necessary to corbel in, beginning at a point about opposite main balcony level and ending on the walls some 6 ft. 6 ins. above the court level. It was safely assumed that the moment, transferred to the columns from the trusses, would distribute itself into the 18-in. reinforced-concrete enclosure walls between the columns that form the side of the auditorium, as well as that the moment by that time would be diminished so that the reduced column

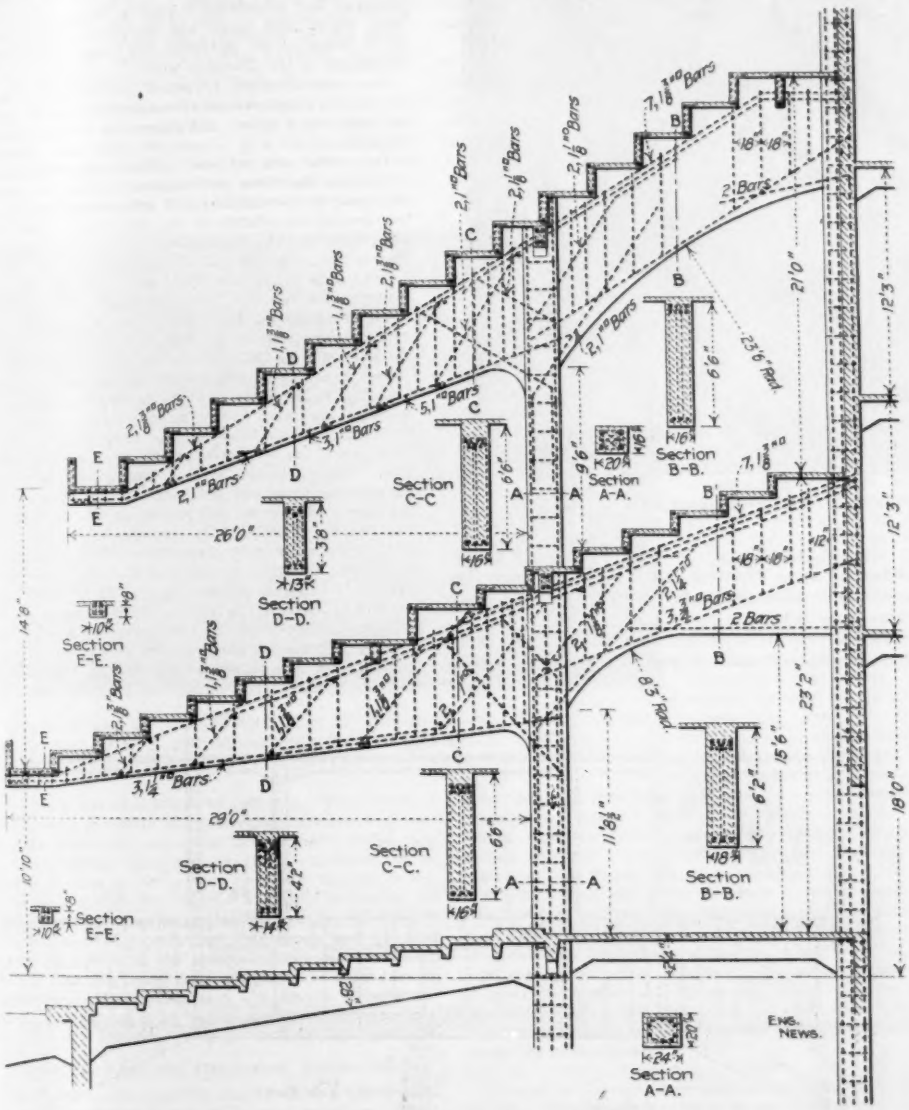


FIG. 3. VERTICAL SECTION THROUGH BALCONY AND GIRDERS SHOWING CENTRAL CANTILEVERS.

section (30 × 36 ins.) would be sufficient to take care of same.

It was found in the design of these columns, that in order to take care of the large negative moment in the trusses at the support, it would take a column of great size and depth, and in order to keep the size of the column within practical limits an innovation was introduced. Instead of stopping the truss columns at the top of the trusses, they were continued up to the level of the next floor with a slightly reduced section, the latter being 36 × 48-in. and reinforced with twelve 1¾-in. square twisted steel bars on the outside, now in compression, and with fourteen 1⅜-in. square twisted steel bars on the inside, now in tension. In this manner the moment at the connection was distributed between the two sections. Transferring a portion of the moment at the support to the upper column section, produced considerable thrust at the next floor level and the amount of this thrust was assumed to be equivalent to that caused by the maximum moment the upper column section was capable of carrying. The transverse beams opposite the columns in this floor were therefore subject to direct compression due to this thrust, as well as to flexure due to floor loading, and they were designed and built as horizontal columns to resist both forces.

METHOD OF HANDLING CONCRETE.—A rather unique and uncommon method of handling concrete was employed on this building. In a convenient place, a tower was erected up one side of which the hoist track was placed and on a platform, some 30 ft. above the work on the building was a hopper, with a capacity of two or three batches of concrete. This tower, track and hopper were elevated as the work progressed story by story. From the hopper, controlled by a gate, the concrete was run into a 7-in. galvanized iron pipe of movable sections and one or more ball-bearing joints, and delivered on the work where desired. Some difficulty was experienced at first by having either too small or too large a pipe, but it was found that a 7-in. pipe was about right, and by running a little water in the pipe before starting and afterwards to clean it out, little or no trouble was had.

This gravity system was very satisfactory both to the contractor by reducing the labor force and to the engineers in charge, by doing away with the running over the form work and newly deposited concrete by a large force of laborers. It also gave a concrete of very uniform consistency in that if too dry it would choke up the pipe and if too wet the aggregate would separate. Properly handled it is very satisfactory.

The building was erected by the Hamburger Realty & Trust Co., and the following Los Angeles firms were connected with its construction: Edelman & Barnett, architects; Mayberry & Parker, design and supervision of reinforced-concrete work, and the F. O. Engstrum Co., contractors for the construction.

## How New York City Submits Applications for Public-Service Franchises to an Engineering Department.

[Contributed.]

Questions relating to the grant of franchises to public service corporations have lately been the subject of much careful consideration and of still more agitation, particularly in the City of New York.

The entire jurisdiction over franchises and the power to grant them was taken from the New York Board of Aldermen by the present city charter and has since been vested wholly in the Board of Estimate and Apportionment. In order that applications for franchises might receive a thorough investigation, and in order that a consistent policy might be followed, the Comptroller of the city established in his own department, in February, 1905, a bureau of franchises which was placed in charge of Mr. Harry P. Nichols, one of the Assistant Engineers of the Department of Finance, who was assigned to this particular work. All applications submitted to the Board of Estimate and Apportionment were thereafter referred to the Comptroller, and the results of the investigations made by his Bureau of Franchises, with proposed forms of grants, were by him submitted to the Board of Estimate and Apportionment.

At the beginning of the year 1906 the Bureau of Franchises was transferred from the Department of Finance to the Board of Estimate and Apportionment, and upon the reorganization of the technical staff of that Board on March 15, 1907, this work was transferred to the Chief Engineer of the Board and the Bureau of Franchises was made one of the divisions of his office, Mr. Nichols being designated as Engineer in charge of the Division of Franchises and reporting to the Chief Engineer of the Board of Estimate and Apportionment, Mr. Nelson P. Lewis, M. Am. Soc. C. E.

The first step of the engineers who were given charge of these investigations in New York City was to secure a standard form of franchises and to establish a uniform scale of compensation for the less important rights which are constantly being applied for, such as those for tunnels or pipes beneath the streets or bridges over them to connect sections of manufacturing plants, warehouses or office buildings which occupied both sides of the same street. The streets being owned in fee by the city, it is held that any private use of these streets should be paid for at its actual value, and that this value is determined by that of the abutting property. No such rights are given in perpetuity, but are granted for a fixed term, usually not exceeding ten years, and may be revoked by the city upon six months' notice.

The present charter law provides that no franchises of any description can be granted for a longer period than 25 years, with provision for a limited renewal upon a reappraisal. If, therefore, the terms imposed by the original grant prove to have been too liberal, an opportunity will be presented to readjust these terms at the end of the first franchise period. It is possible that the imposition of unnecessarily rigorous conditions or too large a money compensation may deter capital from investing in an enterprise which would result in the building up of suburban territory and in a large increase in values which would be of great advantage to the city. No one can so far foresee the future development of any particular section as to enable him to estimate accurately the value of the right to serve the people of this territory for a period of 25 years. To retard such development by the imposition of terms which would deter corporations who are ready to serve it would be unwise, especially as the period covered by the grant is limited to 25 years, at the expiration of which there could be a readjustment of terms. In other words, the public-service corporations and the city should share the risks due to the uncertainty of the direction which new development will take.

The impossibility of foreseeing the direction of such development has been frequently demon-

strated, in no case more notably than at the national Capital, where an opportunity presented itself to lay out a new city and the originators of this plan confidently expected that the portion of the city east of the Capitol building would first be developed, whereas the growth for the first half century was almost wholly in the opposite direction.

FIG. 4. VIEW OF UNDER SIDE OF THE 27-FT. CANTILEVERS, MAJESTIC THEATER.

The Division of Franchises having gathered and considered the facts pertaining to each application for a permit or franchise submits a report to the Chief Engineer of the Board of Estimate and Apportionment. This report reviews the proceedings to date, including the data in hand, presents its recommendations on special points not covered by the model grant or franchise and, if the granting of the application is advised, concludes with a "Proposed Form of Contract," which is virtually a grant or franchise, ready for execution. All the more important documents of this kind are printed in standard form. The Chief Engineer submits these reports, with his approval, or with suggestions for amendments, to the Board of Estimate and Apportionment, which in turn approves the report and the franchise form, with or without amendments, as it may see fit. Thereafter, nothing remains to be done, save the advertising of the term of the franchise or contract required by law and its execution by the Mayor of the City of New York, and the President of the company receiving the grant, together with the corresponding official seals.

It should be noted that before the Board takes final action on a franchise or contract form a public hearing must be given, after at least 30 days' notice; also that a three-fourths vote is required to adopt one of these forms, and that the mayor, quite apart from his membership in the Board, has absolute final power of approval or non-approval of franchise-contract forms.

The plan of placing investigations of this kind in charge of an engineer instead of a lawyer or a politician is unique and is one of many recent instances of the growing tendency of administrative officers to rely more and more upon the engineer or the man of engineering training.

Criticisms of this plan and of the results obtained under it have not been lacking. It has been said that there was a disposition to make too abrupt and radical a departure from the old methods and policies, and that the terms proposed in the reports submitted by this engineering organization were so severe as to deter capital from undertaking new transportation or other public-service enterprises. It is a notorious fact that under the policies formerly prevailing in New York and other cities valuable rights to use the public streets were disposed of for no consideration or a very inadequate one, while applications which were backed by proper influence were granted and others offering much more favorable terms for both city and citizen were rejected.

The writer believes that the City of New York has instituted an admirable policy in dealing with its franchise questions. It is hoped that the engineers who have been given jurisdiction over these questions will display as much judgment and foresight in handling them as they have already shown integrity and enthusiasm for what they believe to be the best interests of the city. Their success in dealing with this difficult problem will reflect further credit upon the engineering profession.

[We append one of the reports of the Franchise Division on an application, condensed so as to save space, but still giving a good general idea of the nature of these reports and of the contract or franchise forms submitted with them.—Ed.]

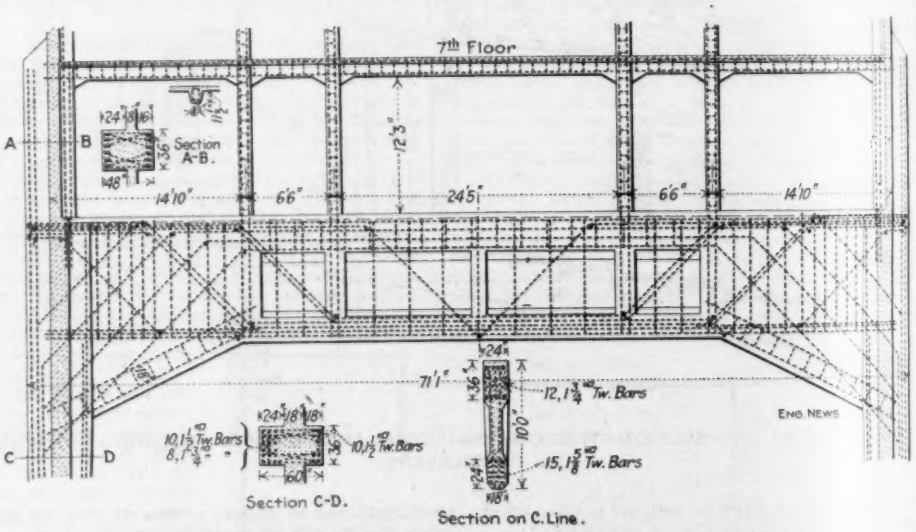


FIG. 5. DETAIL OF HEAVY REINFORCED-CONCRETE ROOF BEAMS.

## Result of Investigation by the Division of Franchises of the Application of the New York Cahill Telharmonic Company for a Franchise to Lay Wires in the Streets of New York for the Purpose of Distributing Music Electrically, with Suggestions as to the Proposed Form of Contract.

Board of Estimate and Apportionment, Division of Franchises, Room 801, No. 277 Broadway, January 31, 1907.

Mr. Nelson P. Lewis, Chief Engineer:

Sir: At the meeting of the Board of Estimate and Apportionment, held February 1, 1907, there was presented a communication from the New York Electric Music Co. stating that it was the intention of the company to apply for a franchise for the right to lay conducting wires in the streets of the City of New York for the purpose of distributing music electrically. It was stated that the company had established a plant at 39th Street and Broadway, where such music was generated and from which it is proposed to distribute the same to subscribers by means of the aforesaid wires.

The communication requested that the matter be referred to an engineer for an examination, for the purpose of preparing a report and suggesting conditions for the franchise.

The matter was referred to the Bureau of Franchises, and since that time an examination has been made of the plant of the company and information obtained from representatives relative to the art of distributing music electrically for the purpose of presenting the facts to the Board, and proposing a form of contract for the franchise.

Under date of May 10, 1907, the formal application was made to the Board for the franchise by the New York Cahill Telharmonic Co. This company filed its certificate of incorporation in the office of the Secretary of State on May 8, 1907. * * *

The franchise applied for is for the purpose of distributing to all parts of the city music generated by a patented apparatus known as the "telharmonium" * * * The principles involved in the construction of the apparatus and the production of the music are purely scientific. The equipment of the company will consist of a distributing plant and a central station. The distributing plant, of course, will consist of cables or wires in the streets, either laid in conduits or strung on poles with house or building connections. This is the part for which the authority is asked in the city of New York. The central station contains the apparatus used to generate and control the music. This consists of, first, numerous alternating-current dynamos, so constructed that each produces a current of different frequency of pulsation or current waves; and second, keyboards similar to that of a piano, upon which the musicians play in order to produce any class of music within the range of the apparatus. The keys are really electric switches, each controlling an electric circuit of one or more dynamos. The frequency of pulsation of the current produced by each dynamo is identical with the frequency of sound waves required to produce a certain musical tone. These electrical waves are changed into sound waves by means of the ordinary telephone receiver. Thus, when the player closes the electric circuit by operating the keys upon the keyboard, he completes an electric circuit which carries the electric waves produced by the dynamos to the point of music outlet, such as a dwelling, hotel, restaurant, music hall, etc. At the point of music outlet, a telephone receiver is attached; here the pulsation of the current is changed by means of the di-

phragm in the telephone receiver into sound waves having the same frequency as that of the current in the wire. The music thus produced may be made to imitate closely other musical instruments, such as piano, flute, violin, etc. The representatives of the company state that when a more complete equipment is installed it will be quite possible to imitate a full orchestra.

The present plant at Broadway and 39th St. consists of 145 dynamos and one keyboard. The president of the company states that other keyboards are ordered, and it is expected that the same will be put in place within a few weeks.

Eleven or twelve places outside of the central station are now connected by means of the wires leased from the New York Telephone Co., but the company states there are a number of inconveniences involved in this arrangement. It is proposed by the company, should it get the franchise, to lay its own wires in the streets, which may be connected to subscribers' houses or places of business. Each subscriber will be provided with one or more outlets which may be governed by him as to the kind of music and volume of the same. He will be furnished with a switch by which he can regulate the music either soft or loud. Another switch will govern the class of music, that is, he may, by turning the switch in one direction, get the effect produced by the piano, or by turning the switch in another direction, he may get the effect produced by an orchestra, etc.

### Peculiarities of the Franchise.

The application in question is unlike any which has heretofore come before the board. It is similar to a telephone application, in that the company asks for the privilege to lay or string wires in the streets of the city, but the commodity to be furnished is entirely different from that of a telephone company. The telephone has become a necessity in transacting business, and has, to many subscribers, an actual money value which can be approximately calculated by them. However, it is hard to imagine at the present time how the use of the telharmonic system can become a general necessity, or of a commercial value to the majority of its subscribers. It is to the public a method of amusement, and for that reason the income of the enterprise will depend almost entirely upon the approval by the public of that class of entertainment rather than upon any degree of necessity for the product caused by having a commercial value, as, for instance, telephones, railways, electric light, gas, etc.

FIG. 6. VIEW OF CONSTRUCTION OF ROOF-BEAMS, SHOWING SIZE AND LAYOUT OF REINFORCEMENT, MAJESTIC THEATER, LOS ANGELES, CAL.

### Conditions for the Proposed Franchise.

By reason of the peculiar nature of the application, the question naturally arises as to what conditions should be imposed in the franchise to properly protect the interests of the city, and at the same time not impose unnecessary burdensome conditions upon the company. Naturally, compensation should be required for the use of the streets somewhat in proportion to the income of the company, such as a percentage of the gross receipts. The security fund should be required to insure the carrying out of the contract by the company. The conditions governing construction and use of the subways should be imposed, but how far should the city go in imposing conditions which will govern rates to charge for the rapidity of construction and efficiency of service, etc., of a company operating a purely amusement enterprise and requiring the use of the streets under a franchise for such operation?

RATES TO BE CHARGED BY COMPANY.—Representatives of the company state that they have absolutely no idea as to what would be a fair rate to charge subscribers for this music. This is due, in a measure, to the fact that the enterprise is entirely new, there being no similar plant in existence furnishing music to a large number of subscribers from which to obtain data as to cost of operation, etc., and it is also due in a measure to the fact that it, being entirely a new enterprise, is subject to many uncertainties which confront all similar ventures; that being especially true in this case because of the extremely scientific nature of the apparatus, many features of which have not been brought to a state of perfection. Again, it is to be the aim of the company to employ the greatest masters of music. The cost of such services are undetermined, and for that reason it is difficult to state in advance what charge should be made to the subscribers to compensate the company for such service. I believe there is good foundation for the claims of the company in regard to rates, and I would suggest, therefore, that no maximum rates be fixed in the franchise, but that a clause be inserted, giving the Board of Estimate and Apportionment control of the rates. Under such a clause the board may exercise its authority to reduce the rates charged, should they at any time appear to be excessive.

I would suggest that the company be required to report at least once each year to the board, giving such information as will aid the board in determining whether the rates are fair, and will act as a guide in determining the revaluations should the contract be renewed.

TIME REQUIRED TO INSTALL PLANT.—The value of the system to any subscriber will not be increased as the number of subscribers increases, as in the case of the telephone. And again, unlike the telephone, the system is not necessary for the welfare of the public, either generally or locally. It seems, therefore, unnecessary to impose a condition requiring a fixed amount of installation within a given time, in order to furnish necessary facilities for the public. However, I believe that any company receiving a franchise from the city authorities should be required to build a plant under its franchise within a fixed period, sufficient in size to show the good faith of the company, otherwise such rights should cease. Franchises without such conditions have in the past been held without use for many years, and have at the end of such period become very valuable and in some instances they have been used for entirely different purposes from that for which they were originally granted, although the city did not receive a revenue therefrom in proportion to the value of the right given. Naturally this company could not complete its entire construction at one time, but would increase its facilities under the franchise from time to time, as the number of subscribers increased. I would suggest, therefore, in order that the franchise shall terminate unless used to some extent within a fixed period, that a clause be inserted requiring 4,000 music outlets installed within a period of three years from the time the franchise is signed by the Mayor. * * *

SUBWAYS.—As there are no public subways except in the Borough of Manhattan and part of the Borough of The Bronx, the granting of a franchise to this company, if it were to cover the entire city, would really mean the granting of two franchises: one for the right to conduct its business in the streets, which requires the use of the public subways, and the other the right to construct subways and erect poles to carry the necessary wires for such business.

* * * * * * * *

In view of the fact that subways must be constructed in other boroughs, I believe it better to limit this franchise at present, should the board grant the same, to the Boroughs of Manhattan and The Bronx, and the portion of Brooklyn known as Coney Island, for I do not consider that the right should be given to any more companies to tear up the pavements of the city, and certainly not in this case, where the commodity to be furnished is not a necessity.

FREE SERVICE.—It is customary to recommend to the board that applications for franchises should, by the terms of the franchise, be required to furnish a certain amount of free service to the city. The service furnished by this company is not of such a character that money value to the city may be derived therefrom. However, music in free wards of hospitals would no doubt be of benefit to convalescent patients under the city's care. I would suggest that the franchise provide for the free installation of the apparatus and free service in such wards in Bellevue and Allied Hospitals in the city as may be required by the board.

Should the Board of Education deem that such service as is to be furnished by the company would be of advantage in the assembly halls of the public schools, for entertainment or instruction, I believe the city should be furnished with service at one-third the rates charged to the general consumer, and a clause has been inserted that the Board of Estimate and Apportionment may require the company, upon the application of the Board of Education, to install and supply service at such rates. In order, however, that the company may not be required to install its apparatus in all public schools at one time, and for that reason be obliged to extend its wires for great distances without receiving adequate revenue therefrom, I would suggest that the company be not required to install apparatus in a school where it is necessary to extend the wires a distance greater than 2,500 ft., and that the company be not required to install apparatus in more than ten schools per annum, where extension of wires is required. Where wires are in the streets adjacent to the block in which schools are situated, the company should be required to install their apparatus, and in addition to the ten schools per annum.

### Compensation.

As hereinbefore stated, the company will probably not require more than six or eight ducts in any street. Of course, there are many streets in which no wires will ever be laid, and there are sections in the city for which no wires will be needed for many years.

As to the probable income of the company, the only data obtainable is that furnished by the company. Under date of March 1, 1907, Mr. Crosby [President of the applying company] addressed a letter to me in which he gave figures showing the anticipated outlay to install the plant and the profits therefrom. The figures given are on a basis of 3,000 outlets installed. * * * The profits calculated would amount to a little less than 10% on the investment, after deducting all expenses of operation and a large item for depreciation.

It is difficult to propose adequate compensation for a privilege to a company to engage in a business which has not yet been tried out. * * * In view of the uncertainty of the success of the company and the apparent large outlay for installation and operation which is required, whether few or many subscribers are obtained, I believe a sliding scale of percentages of gross receipts to be the most equitable manner by which to fix the compensation.

It must be remembered, however, in fixing compensation for this service, that the company is not supplying a necessity, and its use of the streets is for the amusement and entertainment of the public, with profit to its stockholders. In other words, it is a public service corporation only incidentally.

It was suggested to the president of the company that $25,000 was a fair amount to pay as an initial sum. Mr. Crosby practically agreed that this amount was fair, but requested that the company be allowed to pay one-half ($12,500) within thirty days after the signing of the contract, and that a year be given to pay the remainder. There seems to be no objection to this arrangement.

I would suggest, therefore, the following amounts be required as compensation for the franchise:

$12,500 within thirty (30) days after the signing of the contract.
$12,500 within thirteen (13) months after the signing of the contract.
During the first five (5) years, 1% of the gross receipts, to be not less than $5,000 per annum.
During the second five years, 2% of the gross receipts, to be not less than $10,000 per annum.
During the third five years, 3% of the gross receipts, to be not less than $20,000 per annum.
During the fourth five years, 4% of the gross receipts, to be not less than $35,000 per annum; and
During the remaining five years, 5% of the gross receipts, to be not less than $60,000 per annum.

### Other Conditions.

The proposed contract is drawn for a 25-year term with a privilege of renewal for a further term of 25 years.

The other conditions which I have proposed are those which have already been discussed in reports upon applications for franchises which require the laying of wires in the streets. The proposed contract provides for the manner in which subways shall be constructed, the replacement of the pavement and the guarantee of the same.

The terms and conditions have been agreed to by Mr. Crosby, with the exception of the assignment clause, in which he asks a modification. As this clause was originally drawn by the Law Department, and the proposed form of contract will have to be submitted to the Corporation Counsel before being adopted by the board, I would suggest that any alteration in this clause be left to the Corporation Counsel.

Following I have given a summary of the conditions which show at a glance the conditions which have been suggested and which may be useful as ready reference for members of the board.

The board has already fixed Friday, June 7, 1907, as the date for the preliminary public hearing, and directed that the same be advertised as provided by law. If the board on that date is inclined to grant the franchise upon the terms submitted herewith in the proposed form of contract, I would suggest that the proposed form of contract be submitted to the Corporation Counsel for

his approval as to form, and to incorporate therein such matter as he may deem necessary to fully protect the interests of the city.

Respectfully, Harry P. Nichols,
Engineer-in-Charge.

### Synopsis of Provisions of Contract.

[Omitted here. Outlines provisions by sections.]

## New York Cahill Telharmonic Co.

### Proposed Form of Contract.

This contract, made this day of , 1907, by and between the City of New York, party of the first part, by the Mayor of said city, acting for and in the name of said city, under and in pursuance of the authority of the Board of Estimate and Apportionment of said city (hereinafter called the board), and the New York Cahill Telharmonic Co., a domestic corporation of the State of New York (hereinafter called the company), party of the second part: witnesseth:

In consideration of the mutual covenants and agreements herein contained, the parties hereto do covenant and agree as follows:

Sec. 1. The city of New York hereby grants to the company, subject to the conditions and provisions hereinafter set forth, the right and privilege to lay, construct, maintain and operate suitable wires or other conductors in conduits under the streets, avenues and highways within the territory comprised in the Borough of Manhattan and that part of the Borough of The Bronx west of the Bronx River, and also to lay, erect, construct, maintain and operate wires or other conductors with the necessary poles and appliances in that part of the Borough of Brooklyn known as Coney Island, and lying south of Gravesend Bay, Coney Island Creek and Sheepshead Bay, and the further right to construct, maintain and operate one convenient line by either subway or pole line for the sole purpose of connecting the generating plant in the Borough of Manhattan with the aforesaid Coney Island district. The grant is for the sole object and purpose of constructing, maintaining and operating a telharmonic system within the said territory; that is, a system for the generation and distribution of music electrically.

Sec. 2. The grant of this privilege is subject to the following conditions:

First—The said right to lay [etc., etc., is granted for] 25 years from the date when this contract is signed by the Mayor, with the privilege of renewal of said contract for a further period of 25 years upon a fair revaluation of said right and privilege.

If the company shall determine to exercise its privilege of renewal it shall make application to the board or any authority which shall be authorized by law to act for the city in place of the board. Such application shall be made at any time not earlier than two years and not later than one year before the expiration of the original term of this contract. The determination of the revaluation shall be sufficient if agreed to in writing by the company and the board, but in no case shall the annual rate of compensation to the city be fixed at a less amount than that sum required to be paid during the year prior to the termination of the original term of this contract. If the company and the board shall not reach such agreement on or before the day one year before the expiration of the original term of this contract, then the annual rate of compensation for such succeeding 25 years shall be reasonable, and either the city (by the board) or the company shall be bound, upon request of the other, to enter into a written agreement with each other, fixing the rate of such compensation at such amount as shall be reasonable, but in no case shall the annual rate so fixed be less than the sum required to be paid for the last year prior to the termination of the original term of this contract, and if the parties shall not forthwith agree upon what is reasonable, then the parties shall enter into a written agreement, fixing such annual rate at such amount as shall be determined by three disinterested freeholders, selected in the following manner:

One disinterested freeholder shall be chosen by the board; one disinterested freeholder shall be chosen by the company. These two shall choose a third disinterested freeholder; and the three so chosen shall act as appraisers and shall make the revaluation aforesaid. Such appraisers shall be chosen at least six months prior to the expiration of the original contract, and their report shall be filed with the Board within tree months after they are chosen. They shall act as appraisers and not as arbitrators. They base their judgment upon their own experience and upon such information as they may obtain by inquiries and investigations without the presence of either party. They shall have the right to examine the books of the company and its officers under oath. The valuation so ascertained, fixed and determined shall be conclusive upon both parties, but no annual sum shall in any event be less than the sum required to be paid for the last year prior to the termination of original term of this contract. If, in any case, the annual rate shall not be fixed prior to the termination of the original term of this contract, then the company shall pay the annual rate theretofore prevailing until the new rate shall be determined, and shall then make up to the city the amount of any excess of the annual rate then determined over the previous annual rate. The compensation and expenses of the said appraisers shall be borne jointly by the city and the company, each paying one-half thereof.

Second—Upon the termination of this original contract or if the same be renewed then at the termination of the said renewal term, or upon the termination of the rights hereby granted for any other cause, or upon the dissolution of the company before such termination, the plant and property of the company used for the generation and distribution of music electrically within the streets and highways of the city shall become the property of the city of New York without cost, and the same may be used by the city for any purpose whatsoever. If, however, at the termination of this grant, as above, the city, by the board, shall so order by resolution, the company shall on thirty (30) days' notice from the board remove any and all of its wires, electrical conductors, pipes, conduits, subways and equipment, or any portion thereof, from any or all of the streets and public places within the limits of the city of New York.

Third—The company shall pay to the city for the said privilege, the following sums of money [as recommended in the main report, already given, with safeguards to prevent default on various accounts peculiar to New York statutes]:

Fifth—The right and privileges hereby granted shall not be assigned, either in whole or in part, or leased or sublet in any manner, either by the act of the company, its successors or assigns, or by operation of law, whether under the provisions of the statute relating to the consolidation or merger of corporations or otherwise, to any person or corporation whatsoever, nor shall the company, its successors or assigns, in any manner consolidate or pool its stock, business or interests or enter into any agreement for a division of business interest or territory, or to prevent competition or a reduction in rates, or acquire, own or make use of or in any manner exercise control over any of the rights, privileges, franchises or stock, or use, own, control or operate any of the property, works, plants or appliances of any such person or corporation without the consent of the city of New York, acting by the board, evidenced by an instrument under seal, anything herein contained to the contrary thereof in any wise notwithstanding, and the granting, giving or waiving of any one or more of such consents shall not render unnecessary any subsequent consent or consents.

Sixth—The board may by resolution direct the company to install free of charge music outlets [for free wards of certain hospitals and also music outlets at one-third rates in public schools, as and under conditions recommended in main report].

Seventh—The company shall [comply with city ordinances] now in force or which may be adopted, affecting telharmonic companies and companies operating electrical conductors in the city of New York.

Eighth—In the Boroughs of Manhattan and The Bronx all cables and wires of the company shall be placed in ducts, conduits or subways (referred to in this paragraph as subways). Such subways shall be leased from the company or companies having control thereof under the provisions of law, or from the city of New York, should it succeed to the rights of such company or companies. [or should the city build subways.] All, or such portions as the board may direct, of the wires and cables of the line leading from the Borough of Manhattan to Coney Island, in the Borough of Brooklyn, and in Coney Island shall be placed in subways. * * * If the company at any time during the term of this contract or its renewal shall construct subways for electrical conductors in any part of the Borough of Brooklyn in which the right is hereby given to place such conductors, it agrees to sell all or any part of them to the city of New York, upon the written demand of the board and upon payment by the city to the company a sum equal to their original cost, less depreciation up to the time of such purchase. The company shall file with the Board on the first day of November of each year a statement, in such detail as may be prescribed by the board, of the moneys actually spent for the construction of such subways. The company shall at all times keep accurate books of account of the money so spent, and authorized representatives of the board shall at any time have access to such books for the purpose of ascertaining the correctness of the company's statement.

If the company shall construct subways of its own in any part of the Borough of Brooklyn, for which authority is hereby given, it shall provide free of charge two ducts, at least 3 ins. in diameter, in every subway for the exclusive use of the city of New York. Such subway, with the exception of the two for the exclusive use of the city, shall be used only by the company, and solely for the purpose of carrying such wires or conductors as are necessary for the operation of its telharmonic system hereby authorized by the city of New York.

Before the construction of such subways, or of any overhead lines, the company shall obtain permits to do the work from the President of the Borough in which such work is to be done and the Commissioner of Water Supply, Gas and Electricity. The company shall perform all the duties which may be imposed upon the company by these officials as conditions upon which such permits are given, provided that such conditions are not inconsistent with the provisions of this contract. The company shall submit to these officials working plans which shall include and show in detail the method of construction of such subways and overhead lines, and the mode of protection and changes in subsurface structures required by such construction.

The company shall bear the expense of keeping in repair for one year after it has been replaced all pavement which may at any time be removed by said company, either for the purpose of constructing or repairing such subways or their appurtenances.

The company shall bear the expense of inspection of all work and construction or removal of such subways as herein provided and may be required by the President of the Borough. The company shall pay the entire cost of the protection and changes of all surface and subsurface structures which may in any way be disturbed by such construction. The privilege of constructing such subways and overhead lines shall be subject to whatever right, title or interest the owners of abutting property or others may have in and upon the streets, avenues and highways in which such subways or overhead lines are constructed.

Ninth—The company shall commence construction within six months from the date of the signing of this contract by the Mayor, and within three years thereafter shall have in operation at least 4,000 music outlets, otherwise this grant shall cease and determine.

Tenth—The company shall file with the Board, on the first day of November in each year, a map, plan or diagram upon which shall be plainly marked and designated the streets and public places in which are then laid and also those proposed to be laid, during the succeeding year, the several conduits and ducts necessary for the cables and wires used and to be used by the company, together with a statement showing the number of ducts in each street and wires in each duct occupied.

Eleventh—It is a condition of this contract that the company shall bear the entire expense of all work undertaken by reason of this grant.

Twelfth—During the term of this contract or its renewal the board shall have absolute power to regulate all rates or charges by the company to consumers, provided that such rates shall be reasonable and fair.

Thirteenth—The company shall not require nor receive from its subscribers any deposit or advance payment in excess of what is reasonably necessary to insure payment of current bills, and on such amounts so paid the company shall pay interest at the statutory rate whenever such money is held for more than one month. Unpaid bills, unless due from its owner, shall never be charged against property, and no person not himself in arrears shall be denied service because any previous occupant of the same premises is in arrears to the company for service.

Fourteenth—The wires of the company shall be employed for no other purposes than those explicitly set forth herein, except by consent of the Board, and the company binds itself not to lay, use, lease or operate wires for illegal purposes or to illegal places.

Fifteenth—The company shall assume all liability to persons or property by reason of the construction or operation of the system authorized by this contract, and it is a condition of this contract that the city of New York shall assume no liability whatsoever to either persons or property on account of the same, and the company hereby agrees to repay to the city any damage which the city shall be compelled to pay by reason of any acts or defaults of the company.

Sixteenth—If the said company, its successors or assigns, shall fail to maintain its structures in good condition throughout the full term of its occupancy of such streets the Board may give written notice to the said company specifying any default on the part of said company, and requiring said company to remedy the same within a reasonable time, and upon the failure of the company to remedy said default within a reasonable time the said company shall for each day thereafter during which the default or defect remains pay to the city of New York a sum of $100 as fixed or liquidated damages, or the said city, in case such structures which may affect the surface of the streets, shall not be put in good condition within a reasonable time after notice by the board aforesaid, shall have the right to make all needed repairs at the expense of the company, in which case the said company shall pay to the city the amount of the cost of such repairs, with legal interest thereon, all of which sums may be deducted from the fund hereinafter provided.

If, for a period of three consecutive months, the telharmonic system of the company shall not be operated, or if the same shall not be operated for a period of six months out of any consecutive twelve months, the board may declare the right and franchise and this contract terminated without further proceedings in law or in equity.

Seventeenth—The company shall at all times keep ac-

curate books of accounts and shall, on or before Nov. 1 in each year, make a verified report to the Comptroller of the city of New York of the business done by the company for the year ending Sept. 30 next preceding. Such report shall contain a statement of the gross receipts received from the operation of the telharmonic system hereby authorized from all subscribers served by the company, together with such other information and in such form and detail as the Comptroller may require. The Comptroller shall have access to all books of the company for the purpose of ascertaining the correctness of its report and may examine its officers under oath.

Eighteenth—The company shall submit a report to the Board not later than Nov. 1 of each year, for the year ending Sept. 30 next preceding, which shall state:

1. The amount of stock issued, for cash, for property;
2. The amount paid in as by last report;
3. The total amount of capital stock paid in;
4. The funded debt by last report;
5. The total amount of funded debt;
6. The floating debt as by last report;
7. The amount of floating debt;
8. The total amount of funded and floating dept;
9. The average rate per annum of interest on funded debt;
10. The amount of dividends paid during the year and the rate of same;
11. The amounts paid for damage to persons or property on account of construction and operation;
12. Total expenses for operation, including salaries;

—and such other information in regard to the business of the company as may be required by the board.

For failure to comply with the foregoing the company shall pay a penalty of $100 a day until such statement is rendered, which may be collected by the Comptroller without notice.

Nineteenth—This grant is upon the express condition that the company, within 30 days after the execution of this contract, and before anything is done in exercise of the rights conferred thereby, shall deposit with the Comptroller of the city of New York the sum of $10,000, either in money or securities to be approved by him, which fund shall be security for the performance by the company of the terms and conditions of the contract, especially those which relate to the payment of the annual charge for the franchise granted, in default of which payment of the annual charge the Comptroller, acting in behalf of the city, shall collect same with interest from such fund after five days' notice in writing to the company. In case of failure of the company to comply with the terms of this contract relating to the filing of annual statements and the commencement and increase of construction, or its neglect or refusal to comply with any demand or direction of the Board or other municipal officials, made pursuant to the terms of the contract, or under the authority of any laws or ordinances now or hereafter in force, in such case and in any of these events the company shall pay to the Comptroller of the city of New York a penalty of $1,000 for each violation, and in case of any violation of the provisions relating to the illegal use of wires, the company shall pay to the Comptroller of said city for each violation a penalty of not less than $100, and not more than $500, to be fixed by the said Comptroller.

The procedure for the imposition and collection of the penalties provided in the grant shall be as follows: [omitted here.]

Twentieth—In case of any violation or breach or failure to comply with any of the provisions of this contract, which shall have been continued for a period of three months after notice given by the Corporation Counsel, the same may be forfeited by a suit brought by the Corporation Counsel on notice of ten days to the company.

Twenty-first—If at any time the powers of the board or any other of the authorities herein mentioned or intended to be mentioned, shall be transferred by law to any other board, authority, officer or officers, then and in such case such other board, authority, officer or officers shall have all the powers, rights and duties herein reserved to or prescribed for the Board or other authorities, officer or officers.

Twenty-second—The word "notice" wherever used in this certificate shall be deemed to mean a written notice. Every such notice to be served upon the company shall be delivered [as commonly provided in such cases.]

Twenty-third—Whenever the term "outlet" or "music outlet" is used in this contract it shall be deemed to mean the diaphragm or music translating device such as is used by the company on the premises of the subscriber.

Twenty-fourth—The company promises, covenants and agrees on its part and behalf to conform to and abide by and perform all the terms, conditions and requirements in this contract fixed and contained.

In witness whereof the party of the first part, by its Mayor, thereunto duly authorized by the Board of Estimate and Apportionment of said city, has caused the corporate name of said city to be hereunto signed and the corporate seal of said city to be hereunto affixed, and the party of the second part, by its officers thereunto duly authorized, has caused its corporate name to be hereunto signed and its corporate seal to be hereunto affixed, the day and year first above written.

THE CITY OF NEW YORK,
[Corporate Seal.] By.....Mayor.
Attest:
..... City Clerk.
NEW YORK CAHILL TELHARMONIC COMPANY,
[Seal.] By .....President.
Attest:
.....Secretary.

## An English Passenger Terminal Station with Novel Track Arrangement.

The several passenger terminal stations in London (England) are as a rule in such congested districts that the provision of additional track facilities to accommodate increasing traffic is a very difficult problem. In the recent reconstruction of the Victoria Station (or west-end terminal) of the London, Brighton & South Coast Ry., a certain amount of widening was possible, but was limited by the fact that the station (as altered) is flanked on one side by an important thoroughfare and on the other side by another railway station.

The principal feature of the plan adopted, therefore, was that the length of the station was increased sufficiently to cover two train lengths, and the tracks are so arranged that trains can approach or leave the inner end of the station without interfering with trains at the outer end. This is effected by placing groups of three tracks between the platforms in the outer portion, while in the inner portion these are reduced to two tracks. The third or middle track of each outer group thus forms a running or approach track to the inner end of the station.

The arrangement will be understood readily by reference to the plan, Fig. 1. There are nine platform tracks for the entire length of the station, but the special feature is that the six tracks, Nos. 2 to 7 (in pairs) at the inner end (north of the Eccleston St. bridge), can be operated independently of the same tracks at the outer end of the station by means of the intermediate tracks 2A, 4A and 6A. The station extended originally only to the Eccleston St. bridge, and had four platforms 600 ft. long, with six platform tracks accommodating six trains. It has now five platforms, 1,200 ft. to 1,420 ft. long, and nine platform tracks accommodating 18 trains.

For illustration of the method of operating, we may take the methods of handling suburban trains during the busy hours. Supposing track No. 4 to be clear, a train may be admitted to the inner part of the station. An engine on a stub siding outside is then allowed to follow it and couple on for the outbound trip. A second train may then be admitted on track No. 4, being stopped by signal at the Eccleston St. bridge. While this train is discharging its passengers, the first one (with outgoing passengers) can be hauled out on track No. 4A. Its engine follows, but stops just beyond the bridge. The second train then pulls into the end of the station to take on outgoing passengers. While

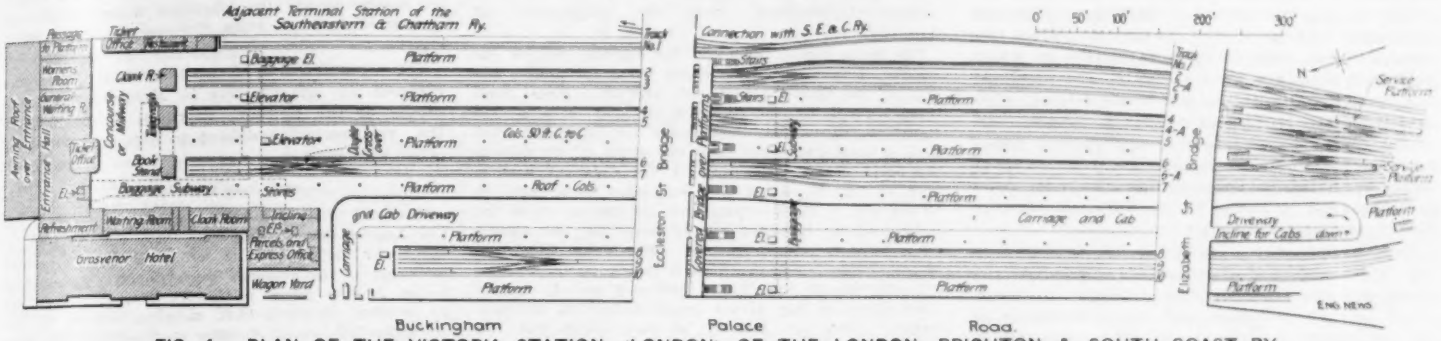


FIG. 1. PLAN OF THE VICTORIA STATION (LONDON) OF THE LONDON, BRIGHTON & SOUTH COAST RY.
(The platforms are from 1,200 to 1,420 ft. long, or sufficient to accommodate two train lengths.)

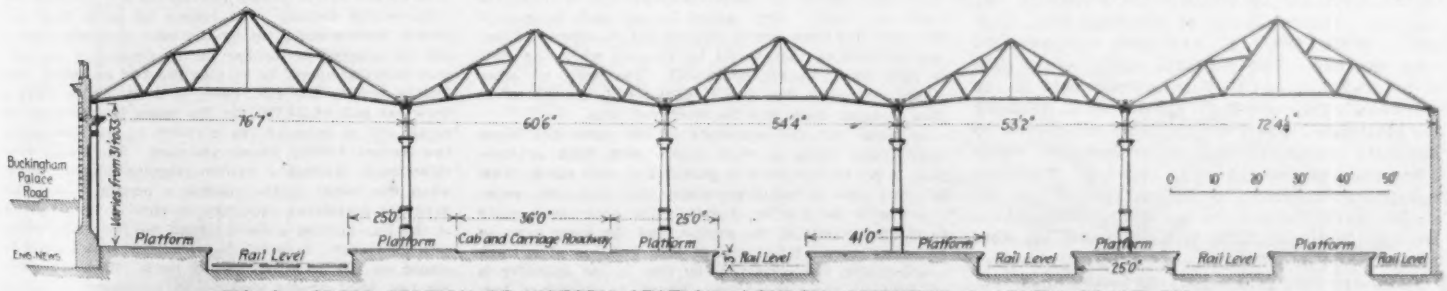


FIG. 2. CROSS SECTION OF VICTORIA STATION; LONDON, BRIGHTON & SOUTH COAST RY.

PASSENGERS' AND EMPLOYEES' RISK of death or injury are in very different ratio on urban passenger railways from the ratio prevailing on main railways. On the latter, as is well known, there are three or four times as many accidents to employees as to passengers. On street-car lines and rapid-transit lines, however, the reverse ratio holds. The 1908 accident figures for New York City, as reported by the Public Service Commission, illustrates this. On main railways (N. Y. C. and N. Y., N. H. & H.) there were 361 injuries to passengers against 1,327 injuries to employees. On the subway and elevated railways of the city there were 5,289 injuries to passengers and 996 to employees. Surface lines (electric conduit lines and horse-car lines) injured 15,528 passengers and 3,938 employees.

standing there, the engine from the first train is coupled to the rear of this second train, ready to take the train out. Trains may discharge passengers at either end of the platform, but they take on passengers only at the inner end.

Tracks Nos. 6 and 7 are so connected by a double crossover that the engine of a train on one track can be switched to the other track (if empty), and then switched to the other end of its own train to take it out. Tracks Nos. 8 and 10 are similarly connected with a middle track No. 9. This provides for releasing the engines of long excursion trains. It may be noted that the suburban and local trains of this railway (and many English railways) are handled mainly by tank engines.

The level of the tracks is somewhat below that of the streets, and two cross streets are carried over the tracks by bridges. One of these bridges is utilized as a means of entrance and exit, having lateral connections with a parallel footbridge inside the station. This footbridge has stairways leading to the platforms. From the second bridge, also, there is an incline by which cabs and carriages have access to the driveway which extends the full length of the station. This driveway is a feature of nearly all English terminal stations, owing to the very general use of cabs for conveying passengers and their baggage direct from the incoming trains. In most cases it is arranged as in the Victoria station, between two platforms for inbound trains.

The various station facilities are arranged in the headhouse, and flanking the concourse. A broad passage leads directly through the headhouse to the concourse, for the convenience of persons going directly to and from the trains. Other means of access are provided beyond the parcels and express office and at the Eccleston St. bridge. Baggage trucks are conveyed to and from the train platforms and main hall by means of a subway and elevators. For baggage from trains discharging at the outer end of the station, there is another subway with an elevator at each platform, so that the baggage can be transferred to the cab driveway. The train platforms are about 3 ft. above the rail level, as is the universal practice in England.

The trainshed is formed by five rows of triangular trusses, ranging in span from 53 ft. 2 ins. to 76 ft. 7 ins. These are supported on the side walls and on four interior lines of columns. The columns are spaced 50 ft. apart, c. to c., longitudinally. The ends of the bottom chords of the trusses are from 31 ft. to 33 ft. above the platform, and at the middle of the span the chord is about 38 ft. to 40 ft. above the rails. Fig. 2 shows a cross section of the trainshed, and shows also the arrangement of the tracks, platforms and cab driveway.

The station is lighted by about 400 lamps burning high-pressure gas which is supplied at 50 ins. pressure by compressors driven by gas engines. The lamps are of the Sugg type, from 175 c. p. to 1,000 c. p.; and have burners fitted with mantles. The platform lamps are of 350 c. p., or 500 c. p. for those on each side of the driveway. They are 50 ft. apart, and 12 ft. above the platforms. They are connected alternately to duplicate mains, so that every lamp or every other lamp can be lighted as required. They are lighted automatically by a flash system. In the station yard, beyond the train platforms, there are four lamps of 1,000 c. p., mounted on steel posts 25 and 30 ft. high.

There are four running tracks in the approach, two being for main line trains and two for local or suburban trains. A fifth track is provided for handling light engines and empty trains between the engine house and car yard and the station, so that these movements can be made without interfering with the regular train movements. There are also numerous sidings beyond the end of the station. The track connections are such that any approach track can be connected with any station track, thus providing great flexibility in the handling of traffic.

The signaling equipment is very elaborate, and is complicated by the peculiar method of operating this as a double-length station. It is on the electro-mechanical system, the switches being operated by the usual manual levers and rods, while the signals are operated by electric motors controlled by small slides or levers in the towers, and having the connections interlocked with the switch levers. A signal tower in the station controls the switches leading to the middle tracks above noted, and also controls the south tower, or main tower outside the station. The former has 21 mechanical and 77 electric levers, while the latter has 106 and 163 levers respectively. An independent tower controls the switches and signals of the car storage sidings. Indicators in the two main towers show whether each section of each track is occupied or not. All the station tracks are provided with electrical detector bars, so arranged that when any track is occupied, the signal for that track is held at the "stop" position. All this plant was installed by the Sykes Interlocking Signal Co., of London. The following particulars of the switch and signal interlocking system are taken (but somewhat modified) from the "Engineer," of London:

The north signal tower (in the station) controls the signals operated from the south tower (outside). The men in the former cannot only prevent a signal from being lowered, but can restore it to "stop" at will. The signal levers in the south tower are controlled also. This is done electrically, and the action of the man in the north cabin is governed by the electrical detector bars, so that he cannot give permission for a signal to be lowered to admit a train into the station unless the track is clear. Neither can he lower his own signals for a train to proceed from the outer to the inner part of the station unless the track is clear.

Tracks Nos. 8 and 10 are protected entirely by the south tower, as they do not extend so far into the inner station. They are, however, of such length that two trains can be admitted on each track. In order to advise enginemen as to how far the track is clear, the inner home signals for these roads are provided with lower distant arms, which are controlled by the detector bars in advance of them. If the tracks are occupied to their full extent, the upper arms cannot be lowered, nor the arms of the outer home signals. If, however, there is room for a train, the upper arm and the outer home signal can be lowered, but the circuit through the detector bars from the upper arm to the lower distant signal will not be completed. Should the track be free, the lowering of the upper arm by the signalman would complete a circuit through the detector bars to the lower distant arm, which would fall to the "proceed" position. The signals actuated from the north tower for starting trains from the inner station are in turn slotted from the south tower. Therefore, no train can be signaled to start from the inner station unless the track is clear. These signals, too, are controlled by the detector bars in advance of them.

In order to allow for switching operations and for the admittance of light engines or short trains for which there is room, lower "calling-on" arms are provided on the outer home signals. These are independent of the north tower, and allow trains or engines to approach under "caution" up to the inner home signals at the entrance to the station. The slides working the electric connections for the home signals are so designed that while they can be put back sufficiently far to throw the signal to "stop," they cannot be put back fully until the train has gone over a detector bar in advance. Thus, the interlocking that would be released when the slide is fully back, cannot be moved. Therefore, no other points or signals that would conflict with the movement that is being made can be interfered with.

In order that the signalmen in the north and south towers may know to what extent each track is occupied, a set of indicators is provided in each cabin. This has two rows of miniature arms, nine in a row, corresponding to the number of roads. The upper arms apply to the inner part of the station, and the lower arms to the outer part. When one or both portions of a track are occupied, the corresponding arm in the indicator is at danger. These indicators prompt the signalmen how to dispose of an incoming train in case its appointed platform is already occupied.

The running signals south of the south tower are of the usual semaphore type. Those north of the south tower (except the inner home signals) are of the electrically-illuminated type; each consists of a red banner centrally pivoted, carried in a disk, with a plain glass in front and an opal background. Behind is a lamp, the light of which shines through the opal glass and gives the same indication by night as by day. All the ground signals for switching are of similar construction, but are smaller.

The semaphore arm is lowered by an electric motor, and held by a clutch. When the signal is released, owing to the signalman restoring the slide in the locking frame, the clutch is withdrawn, and the signal goes to danger by its own weight. The illumi[nant] carried on a spindle, at one end of wh[ich] armature which is attracted by a coil th[rough] when the signal has to be cleared. When [the] to be placed again in the danger or "stop" [position], the coil is de-energised, and the banner goes [to the] "stop" position.

All signals, both running and switching [are provided] with electrical detectors which guarantee [that] the route is properly set, but that both t[he switches are] in their proper position. The usual lock[ing] bars are provided for all switches that are [normally] used in a facing direction. This apparatus [is also con]nected to the signals, which cannot be l[owered unless] the switches are in their proper position, t[he lock plun]ger in place, and the locking-bar raised. Fu[rther, should] any of these be subsequently disturbed, as [by the switch] being run through, the signal will be thro[wn to danger] or "stop." At some switches, there are el[ectrical lock]ing bars which stand normal with the top [of the rail]. When a bar is depressed by a train standing [on it, the] plunger is locked in, so that it cannot be [withdrawn,] and therefore the switches cannot be disturb[ed. Should] the plunger be out, the depression of the l[ever does not] prevent the plunger being shot and the sw[itch being] secured.

The reconstruction of this important station was planned by Mr. Charles L. Morgan, Chief Engineer of the London, Brighton & South Coast Ry., and we are indebted to him for plans and other information.

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**SURVEYS FOR $3,500,000** highway improvements in Los Angeles County, California, have recently been begun under the direction of Mr. A. E. Loder, engineer-in-charge of the proposed improvements. According to a Los Angeles paper, a network of county roads will be provided, having a 16-ft. macadam strip in the center and a 7-ft. gravel shoulder on either side, the whole width of the roadway being treated with asphaltic oil.

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**AN ELECTRIC MOUNTAIN RAILWAY** in Tyrol is described in London "Electrical Engineering," of Dec. 10, with credit to "Electrische Kraftbetriebe und Bahnen." The line described is known as the Rittner line and runs northeast from Bozen, between the valleys of the Eisak and Talfer, up the side of the Rittnerberg and along a plateau at its top. The line is single track, about eight miles long and some two and a half miles has a central rack rail. Direct current at 750 volts is supplied to trains, by a double overhead contact line. Power is furnished by a hydro-electric station, which also supplies several towns with light and power. The railway sub-station is located at about the mid-point of the rack rail and is 22 miles from the main station. Three-phase current at 10,000 volts and 46 cycles is taken from an underground cable running alongside the track. The cable also carries current for two towns and is 30 miles long. In the sub-station a squirrel-cage induction motor drives the direct current machine. This converter is started by a battery on the direct-current line provided mainly for carrying the peak loads.

Each train is composed of a motor-car and a locomotive. The motor cars have the usual direct-current railway motors and operate over the ordinary gradients of the line. On the rack portions the locomotives take the motor cars up and down. These locomotives are driven by two shunt-wound motors. The reason for using these particular motors seems to be the ease with which power can be returned to the line during descent, at any ordinary range of speed, by varying the field excitation. The motors develop 150 HP., each, at 4 mi. per hr., with a draw-bar pull of 13,750 lbs. To lessen the stress on the racks and to increase the stability of the locomotives, two toothed driving wheels are used. The motors drive these gears through a friction coupling adjusted to slip when the motor torque reaches a certain value. This device is considered necessary in view of the possibility of the line making a short circuit for the motor (acting as a generator), in which case excessive stress would be placed on the rack and pinion teeth. Each locomotive has two hand brakes working on corrugated pulleys on each of the gear axles.

Each motor car has two 45-HP. motors with common series-parallel control. These cars have four axles and weigh 21 tons empty. Their seating capacity is 58. As the locomotive weighs 16.3 tons, the train weight per seat is about 1,300 lbs.

The first section of the line, about a half-mile in length, runs through the streets of Bozen and is practically level. In the next stretch, of about two and a half miles, the total difference in elevation is nearly 3,000 ft., with a maximum track gradient of over 25%. The remaining five miles is nearly level. On the steep stretch, the track is of 45-lb. T-rails in 40-ft. the rail is a wedge-shaped section with a gripping device, not described, to prevent the gear mounting the teeth.

## A Notable Typhoid Epidemic at Mankato, Minn.

By F. [illegible] BASS,* Assoc. M. Am. Soc. C. E.

Until the summer of 1908 the city of Mankato had for [illegible] years been practically free from typhoid [illegible]. On June 27, 1908, there suddenly swept over the city like a threatening cloud a sudden [illegible] general epidemic of diarrhoea, 2,000 or more [illegible] the 12,000 inhabitants being affected. The threat of this cloud was realized, for with an explosive [illegible] destructive violence an epidemic of typhoid [illegible] lowed three weeks later. Within the next four months the Health Commissioner of the city recorded over 400 cases and 25 deaths within the city. Outside of the city and within the boundaries of Minnesota 72 other cases and 5 deaths were traced to Mankato. Were it not for prompt and effectual preventive measures the epidemic would have assumed much larger proportions. Of the 450 cases less than 40 were secondary.

Mankato is situated in the south-central part of Minnesota on the east bank of the Minnesota River. Heavy rains during the early summer had caused the highest water in the Minnesota since 1881. The crest of the flood occurred June 25. On this date there also occurred in Mankato an extremely heavy rain, the run-off of which from the precipitous slope immediately east of the city flooded to a depth of over a foot several of the streets, including the one on which the wells supplying the city are located.

The preliminary visitation caused some alarm, but no great apprehension of danger was felt. It was, however, serious enough to be given considerable prominence in the local papers. A press notice came to the attention of the Secretary of the State Board of Health, Dr. Bracken, who lost no time in getting to Mankato. With him went Dr. H. W. Hill, Assistant Director of the laboratories of the board. The explosive and general nature of the epidemic caused them to suspect the water-supply, although the authorities told them the contamination of the water-supply was a physical impossibility. Nevertheless an examination of the sources of water-supply was made and the conditions found amply justified the suspicions.

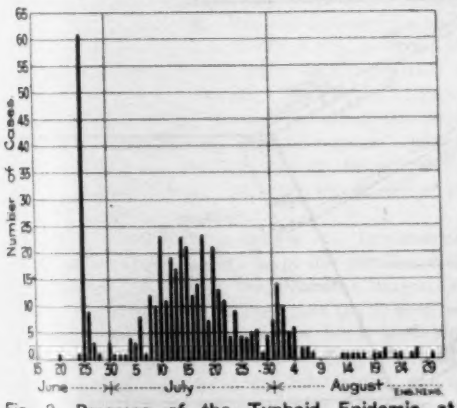



Fig. 2. Progress of the Typhoid Epidemic at Mankato, Minn., June-August, 1908.

Fig. 1, a partial map of the city, shows the location of the various wells from which the city supply is drawn. Those on Washington Ave. are owned by the city; the other two connected to the city supply are owned by the Mankato Electric Light Co.

A few days after the visit of Doctors Bracken and Hill, the writer, as Engineer for the State Board of Health, visited the city for the purpose of obtaining more exact information as to the construction of the wells and their relation to possible sources of contamination. Two of the wells had already at this time been put out of service and the city was depending upon the wells of the Electric Light Co. for part of its supply. It was also the purpose of this visit to recommend improvements so that these wells could be put back into service without endangering the quality of the water.

The description of the conditions in detail has been omitted in response to the request of the city attorney of Mankato. There are pending some 75 suits for damages consequent upon this epidemic, and until these are settled the writer agrees with the city attorney that these conditions should be withheld from publication.

FIG. 1. MAP OF A PORTION OF MANKATO, MINN., SHOWING LOCATION OF ARTESIAN WELLS FORMING WATER SUPPLY.

All of the conditions making possible the contamination of the city water were unknown to the city council, to the board of public works and to the health commissioner. Mankato citizens as well as the city officials prided themselves on their supply of pure water. It was one of the assets of the community. The organization of the city government was such, however, that no one person was specifically charged with responsibility of the water-supply and given control over it. It would be difficult to lay the blame at the door of any one person. Any one of several, had they fully apprehended the situation, could possibly have averted the catastrophe; that is, if their words would have been heeded, which is improbable.

There is no doubt of this fact: that Mankato was thoroughly awakened, and the ability of the community shown in meeting the emergency is worthy of the highest praise.

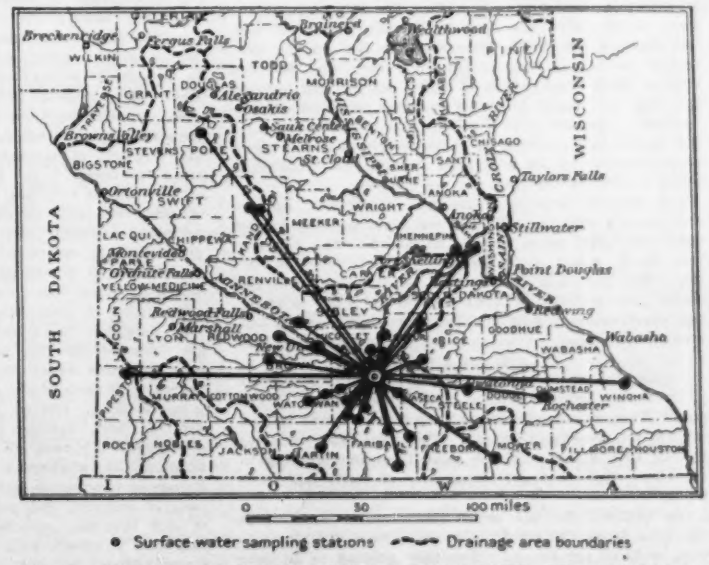
That an artesian-well water-supply should be seriously contaminated is unusual, but that a typhoid epidemic having an aggregate of 500 cases should be suppressed in a few months with less than 40 secondary cases is not only unusual, but very remarkable. This very creditable work was chiefly due to the able direction of Dr. H. W. Hill. It was also due to the unremitting vigilance, determination and executive ability of Dr. A. O. Bjelland, of Mankato, and his assistants.

Immediately upon the appearance of the outbreak of diarrhoea, the danger of a typhoid epidemic later was recognized, and Dr. Bjelland issued in the local papers an interview, printed on the front pages, the headline of which was "BOIL THE WATER." This was done on June 27, and on the next day a street-cleaning department was organized under a special sanitary inspector. Then a "clean-up" notice was run in the papers. Lime was poured into every privy in the city. All piles of garbage and manure were collected and removed. Later, the Minnesota State Board of Health's placard in regard to typhoid, together with special instructions for those caring for patients and also information as to how typhoid could be contracted, were published daily in conspicuous places on the front pages of the newspapers. No doubt this use of the press was one of the most powerful agents in this campaign of forced education.

An emergency hospital was organized. The German Catholic school building was placed at the disposal of the city through the good offices of Dr. Hegeman, and the Sisters of the Sorrowful Mother furnished twelve nurses. In three days a 35-bed hospital was ready for use and during the epidemic 129 patients were cared for. The city spent $800 for equipment.

Special rooms were rented for temporary offices of the health commissioner; an assistant health officer, a stenographer and two visiting nurses were employed. These two nurses, Miss Jessie Clark and Miss Grace Robinson, both of wide experience, visited each household in which typhoid existed, gathered data and gave personal instruction in the care of patients and prevention of infection. Letters of caution in regard to the use of city water were sent to every drug store, restaurant, saloon, hotel, boarding-house, grocery, milk-dealer, confectionery dealer, ice-cream and soda-water dispenser, to all cooks, waitresses and helpers in public places.

Fig. 2 shows the progress of the epidemic; the first symptoms are indicated by the date. Fig. 3 is a map of Southern Minnesota, showing the points to which typhoid was carried from Mankato. At present the typhoid fever rate is above the usual in Minnesota, whether from the effects of the Mankato epidemic or not is somewhat uncertain, but in all probability in some degree due to that cause.




• Surface-water sampling stations —•— Drainage area boundaries

FIG. 3. MAP OF SOUTHERN HALF OF THE STATE OF MINNESOTA, SHOWING SPREAD OF TYPHOID INFECTION FROM MANKATO FOLLOWING EPIDEMIC OF 1908.

Some years ago a typhoid epidemic occurred in Breckenridge, Minn. No particular steps were taken to suppress it, and the State Board of

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Health was not consulted. A resident of that city stated to the writer that steps were even taken to conceal the fact that there was an epidemic, and this is probable, since it is an almost universal practice on the part of many excusably ignorant city officials. In this epidemic there were approximately 800 cases, less than one-half primary.

Compare this with the Mankato epidemic, and it is as comparable as such things could well be, and the efficiency of the work of Dr. Hill and the others is shown in its true perspective. That work in all human probability saved from twenty to thirty lives and prevented four to five hundred persons from contracting the disease. It controlled the epidemic in less than three months and entirely eliminated the disease from the city within five months.

To prevent a recurrence of such a disaster, the city of Mankato has employed a special sanitary engineer, Mr. John Wilson, formerly of Minneapolis, who is now engaged in repairing and reconstructing the wells and parts of the sewer system of the city. Fig. 4 illustrates the proposed methods of reconstruction of the artesian wells.

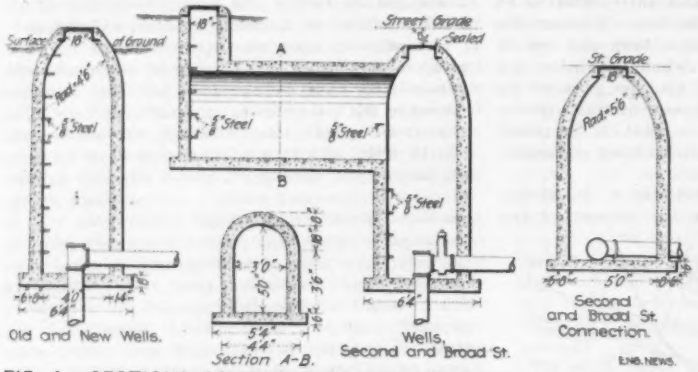


FIG. 4. SECTIONS OF MANHOLES AND WELL PIT FOR ARTESIAN WELLS AT MANKATO, MINN., BUILT AFTER TYPHOID EPIDEMIC.

## Method and Cost of Highway Improvement in Allen County, Indiana.*

By G. E. MARTIN.†

In Indiana, Allen County has for many years been noted for its good roads. Having three rivers within its boundaries, and also several beds of gravel, a good supply of gravel has been easily obtainable. With this material many miles of good gravel roads have been constructed.

In the past few years, however, a considerable length of macadam road has been built. The largest improvement of this kind has been in Maumee Township, and was finished last fall. This township lies on the east side of the county, next to the Ohio line. The soil is a kind of black muck which is easily cut up, and hauling over the dirt roads in the wet season was almost impossible. The town of Woodburn, on the Wabash Ry., lies almost in the center of the township, and the roads were constructed in a system leading to Woodburn, which is the market town for the township.

The recently improved road was constructed on the double-track system, with the macadam portion on the right for teams going toward Woodburn. The highway was 40 ft. wide, with the grade 26 ft. wide on the top. The macadam portion was 10 ft. wide from the center line, with a 3-ft. bank to hold the stone in place. The stone was placed 10 ins. deep on the sides and 12 ins. deep in the center. About 1 in. of screenings was placed on top of this, 7 ft. wide, as a top dressing.

Crusher-run stone was specified to be used, but owing to its irregular composition, ruts were formed in the road. Then 2½-in. stone was used for the lower course, with ¼-in. screenings on top. The stone was furnished by the Erie Stone Co., and came from the Huntington quarries. The length of the system of roads was 11.48 miles.

The contract for the entire improvement was let to the Erie Stone Co. for $32,792, or a cost of $2,854 per mile or $1.62 per lin. yd. The only grading to be done was to smooth the road to receive the stone and furnish earth to hold it in place, except that in one instance a cut and fill of about 4 ft. were made.

The grading was estimated at $50 per mile, and cost about that on the average. Stone cost $1.10 per cu. yd. on the cars at Woodburn. The average cost of hauling it to the road was 20 cts. per cu. yd., or 10 cts. per cu. yd. per mile. About 2 yds. to a load were hauled, the farmers in the vicinity doing the work. The teamsters were required to help fill the wagons, though laborers were furnished at the cars to assist them. Spreading the stone on the road cost 14 cts. per cu. yd. The road was drained by 4-in. tile on each side of the road where tile was not already laid. This cost about 6 cts. per lin. yd. A roller was not used on the work, the action of the teams hauling over it being depended upon to pack the stone.

The township was bonded for $34,080 to furnish money for the improvement. These bonds were of 40 equal series of $852 each, bearing date of July 15, 1907. The first are payable May 15, 1908, and one on each succeeding Nov. 15 and May 15 until all are paid. The bonds bear interest at 4½%, making the interest $19.17 every six months on each bond. The entire issue was sold at par. To meet the payment of these bonds a tax levy of 48 cts. per $100 was made in Maumee Township.

The following is a summary of the cost data:

| | |
|---|---|
| Stone per mile, cu. yds. | 1,800 |
| Cost per cu. yd. of stone on cars | $1.10 |
| Cost of haul per cu. yd. per mile | 0.10 |
| Cost of spreading per cu. yd. | 0.14 |
| Cost per cu. yd. of stone in place | 1.44 |
| No. of sq. yds. per mile of roadway | 5,867 |
| Cost of grading per sq. yd. | 0.09 |
| Cost of finished roadway per sq. yd. | 0.48½ |

The town of Woodburn (about 300 inhabitants) seized this opportunity to improve its streets. Two streets were improved with concrete curb and gutter, and two with stone alone. The improvement in the town was under separate contract with the Erie Stone Co. The average cost of grading was 15 cts. per cu. yd. Stone cost $1.10 per cu. yd., and hauling and spreading 40 cts. per cu. yd. The actual cost for hauling and spreading was less than 25 cts. per cu. yd.

Concrete curb and gutter was constructed with 6-in. curb and 18-in. gutter 12 ins. deep. This cost 55 cts. per lin. ft. Headers of curbing alone were constructed for 35 cts. per linear foot. Combined curb and gutter sewer inlets were placed for $7.50 each, and manhole covers for the catchbasins at $4.50 each. The catchbasins were built by the town. Cement sidewalk was constructed under the same contract for 12 cts. per sq. ft.

*Abstract of a paper read at the annual meeting of the Indiana Engineering Society at Indianapolis, Ind., Jan. 14 to 16, 1909.

†224 Sheetz St., West Lafayette, Ind.

TESTS OF BRIDGE MEMBERS and details are being conducted by a joint committee of German bridge works, with the cooperation of the Departments of Public Works and Education. A memorandum of their working program has been given recently in the "Zeitschrift des Vereins Deutscher Ingenieure" by A. Seydel, who is in charge of the preparatory work. The program includes first, preliminary tests on rivet connections, comprising, (1) influence of various riveting processes, (2) value of the conical enlarged base of the rivet-head (found in German practice), (3) influence of the nature of the inner surfaces of the plates, whether black, or pickled and oiled, or also painted. The principal tests, which are tests of full-size members and joints, cover the following: (1) tests of the slipping point of riveted connections with various rivet groupings; (2) tests to determine the weakening influence of the rivet holes; (3) tests of eccentric end details of stiff members; (4) buckling tests of struts, with different types of latticing; (5) tests of the lateral rigidity and buckling strength

It seems that the preliminary tests (on rivet connections) are well under way, and that preparations have been made for some of the main tests. Others of the latter, however, can hardly have been planned in great detail as yet, to judge from the manner in which they are stated. It is proposed to build a testing-machine of 3,000 tons capacity in both tension and compression.

## The Detailing of Skew Portals.

By J. P. DAVIES.*

Skew portals will be herein designated as "double-plane" or "single-plane" portals, depending upon whether they consist of two planes or bracing systems of bracing connected by lattice-bars, etc., or only one plane having itself sufficient lateral stiffness. Double-plane portals are the most complicated and are the hardest to erect. They are used where great stiffness is desired, as in a heavy riveted bridge, or where a wide bridge and a large skew render a deep portal imperative to secure the requisite lateral stiffness. Single-plane portals are easier to construct and erect and are more easily adapted to pin-connected bridges than the double-plane type. For highway and light railroad bridges a type of portal that is very common and cheap is a single-plane portal placed in the plane of the outer face of the end posts, instead of in the plane of their center lines. Such a portal in its simplest form may be said to consist of the front plane of a double-plane portal, the top and bottom struts however being composed of two angles, of which the front one is bent at the ends and riveted directly to the cover plate of the end post.

The details for the connection of the portal to the trusses are often quite complicated; those shown herein are merely typical, but it is believed that the formulas given will enable the dimensions of any other detail to be computed.

FORMULAS.—Let the end plane $A\ B\ C\ D$, Fig. 1, be called the "portal-plane," $A\ C$ and $B\ D$ being the end posts. Two planes are drawn at right angles to the portal-plane; one of these, $C\ F\ G$, passes through the hip-vertical $C\ G$, and the other, $B\ J\ H$, passes through the transverse line $B\ J$ (drawn at right angles to the truss chord $A\ G$). Draw also the hip-vertical $D\ E$.

The angle $F\ C\ D$ = angle $C\ F\ A$ will be a right angle, from the construction.

The various angles which occur about the portal will be denoted as follows:

$\alpha$ = angle $J\ B\ A$ = angle $F\ G\ A$ = angle of skew.

$\theta$ = angle $A\ C\ G$ = angle $B\ D\ E$ = angle between end-post and vertical.

$\beta$ (the "detailing angle") = angle $A\ C\ F$ = the amount by which the angle between the end-post and the portal strut differs from 90°.

$\delta$ (the "hitch-plate angle") = angle $H\ B\ J$ = the amount by which the angle between the portal-plane and the plane of the truss differs from a right angle.

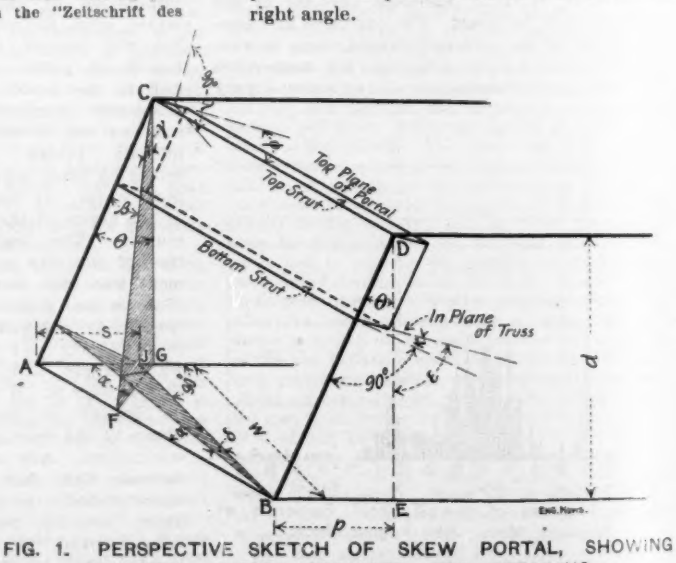


FIG. 1. PERSPECTIVE SKETCH OF SKEW PORTAL, SHOWING PRINCIPAL ANGLES REQUIRED FOR DETAILING.

$\gamma$ (the "vertical-bend angle") = angle $F\ C\ G$ = the angle between the portal-plane and a vertical plane through the portal-strut $C\ D$.

$\epsilon$ (in plane of truss) = the angle which the *intersection line* of the top (or bottom) plane of the portal with the plane of the truss, makes with

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the vertical. (NOTE:—The "top plane of the portal" is perpendicular to the "portal-plane.")

$\kappa$ (the "skew on end-post angle") = the difference between 90° and the angle which the intersection of the top (or bottom) plane of the portal and the plane of the truss makes with the end-post.

$\phi$ (the "top-cut angle") = the angle which the *intersection line* of the top plane of the portal with the plane of the truss makes with the portal-strut.

$\lambda$ (the "top-bend angle") = the difference between 90° and the angle between top plane of the portal and plane of the truss.

The values of these angles may be found by the following formulas:

$$\tan\theta = \frac{BE}{ED} = \frac{p}{d}\left(=\frac{\text{hip panel length}}{\text{depth}}\right) \quad (1)$$

$$\tan\alpha = \frac{AJ}{JB} = \frac{s}{w}\left(=\frac{\text{skew}}{\text{width}}\right) \quad (2)$$

$$\sin\beta = \sin\alpha\sin\theta \quad (3)$$

$$\tan\gamma = \tan\theta\cos\alpha \quad (4)$$

$$\tan\delta = \tan\alpha\cos\theta \quad (5)$$

$$\cot\epsilon = \cos\alpha\tan\gamma \quad (6)$$

$$\kappa = \epsilon + \theta - 90° \quad (7)$$

$$\cos\phi = \frac{\sin\delta\sin(\epsilon+\theta)}{\cos\beta} \quad (8)$$

$$\tan\lambda = \frac{\sin(90°-\epsilon)}{\tan(90°-\alpha)} \quad (9)$$

Check formulas:

$$\tan\kappa = \sin\delta\tan\beta \quad (10)$$

$$\sin\phi = \sqrt{\frac{\tan^2(90°-\alpha)+\sin^2(90°-\epsilon)}{\tan^2(90°-\alpha)+1}} \quad (11)$$

These formulas are sufficient to give all bends, cuts and bevels required for the complete details of a portal.

### Detailing A Double-Plane Portal.

MAKE-UP OF PORTAL.—The portal described will consist of top and bottom portal-struts of two 5 × 3½ × ⅝-in. angles laced, connected by a triangular web system and braced to the end-post by kneebraces of two angles laced. The portal will be connected to the trusses by bent hitch-plates riveted to the top and bottom faces of the end-post. The top strut will also be connected to the side of the top chord by means of bent plates or angles.

PRELIMINARY LAYOUT.—To fix the governing dimensions of the portal, a preliminary layout should first be made, to a scale of about ⅜ in. =1 ft., showing end, side and horizontal projections of the end of the span with the clearance diagram or lines in each. The working width of the span, $w$ in the formulas, is the distance between the bend-lines of the hitch-plates or about 1 in. less than the inside distance between edges of cover-plates on the end-posts or top-chords. The skew $s$ is the advance of one end-pin beyond the other; the depth $d$ and distance $BE = p$, are the regular center to center distances. The top line of the portal will usually be about ⅝ in. below the top corner of the end-post and top chord.

Such a layout is shown by Fig. 2. In constructing it, draw in the lower line of the portal and the kneebraces so as to hug the clearance diagram as closely as desired. Here note that the lowest line of the portal-strut will be in the back plane, the lowest line of the forward kneebrace (except where skew is small) will be in the front plane, and the lowest line of the rear kneebrace will be in the back plane of the portal; the proper respective planes must be used in projecting. Then project the points $g$, $h$, $a$, $b$, $e$ and $f$ to $g'$, $h'$, $a'$, $b'$, $e'$, and $f'$, each to its proper plane.

To determine the line on the side of the end post where the lower (or upper) plane of the portal (perpendicular to the portal plane) strikes it, find the angle $\kappa$ from eq. (10), $\tan\kappa = \sin\delta\tan\beta$, lay off $a'j'$ and $b'k'$ as shown at the points $a'$ and $b'$ and join $j'k'$ which will be the front edge of the portal. Project $a'$, $b'$, $j'$, $k'$ to the horizontal projection as $a''$, $b''$, $j''$, $k''$ and join $a''b''$, $j''k''$.

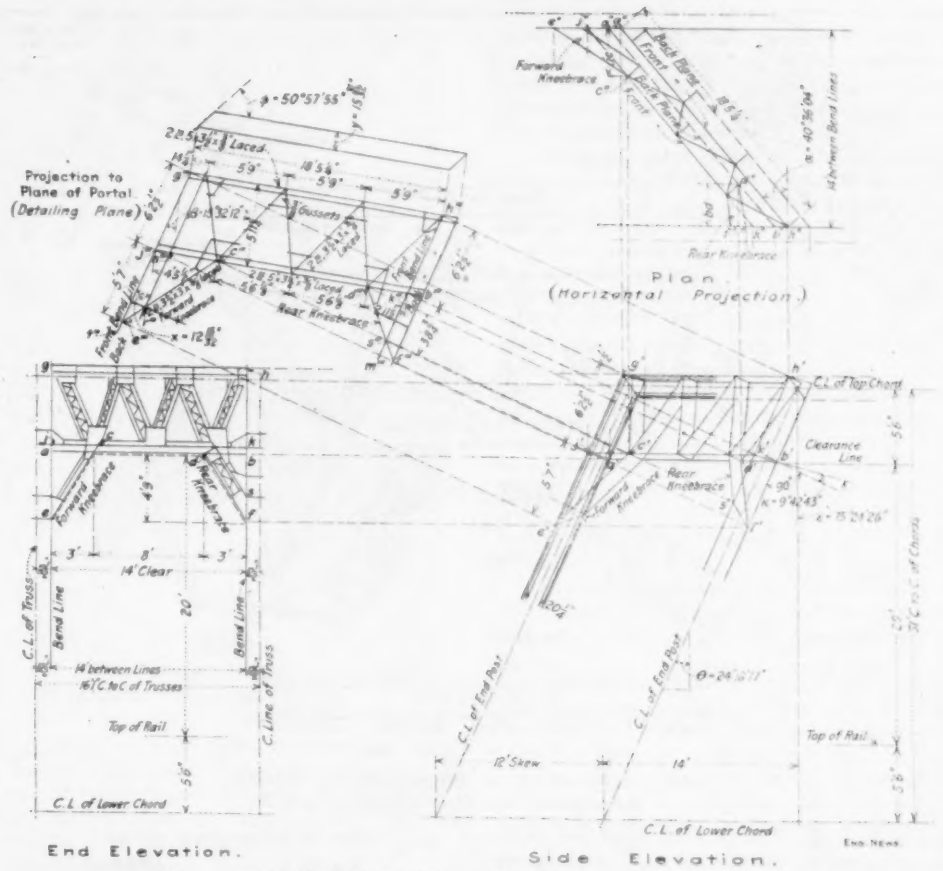



FIG. 2. PRELIMINARY LAY OUT FOR DOUBLE-PLANE PORTAL.

To locate the kneebraces: the line $df$ can be drawn in at once, $f$ projected to $f'$, distance $bd$ laid off on the horizontal projection and point $d''$ projected down to $d'$, working always in the back plane of the portal. In the same manner, working in the front plane of the portal, $ec$ can be drawn in on the end view, distance $jc$ laid off on the horizontal view to give $c''$, and $c''$ projected down to $c'$.

To project on to the portal-plane (the detailing plane), project $h'$ and $g'$ perpendicular to the end-posts and take a line $h'''g''' = g''h''$ ($g''h''$ must be calculated from distance $ab$ and the skew). Draw $g'''t'''$ and $h'''m'''$ parallel to the end-posts; these will be the "bend-lines" for the front portal-plane. The bend-lines of the back portal-plane will be seen in this view offset from those of the front plane, the amount of offset evidently depending upon the angle of skew and the depth of the end-post. To find this distance $x$ (in the portal-plane) between bend-lines of front and back planes, find

$$x = v\sin\delta$$

where $v$ is the depth of end-post between hitch-plates. Draw in the back bend-lines and continue the projection as shown, locating the points $c'''$, $d'''$, $e'''$, and $f'''$.

The trussing system may now be drawn in as desired in the portal plane and projected back to the end view to give the finished appearance of the portal. Note that the trussing members form planes perpendicular to the plane of the portal, so that if a member consists of two angles, only one will be seen in the detailed view, but in the end view of bridge both will be seen at an angle. The end web-members should connect far enough within the bend-lines to give room for the end connections of the portal struts to the bridge-trusses.

If, as before noted, it happens that the skew is small, there is a likelihood that the lowest line of the forward kneebrace may be in the back portal plane, as is the case in a square bridge. If this is so, and there is danger of the forward kneebrace encroaching on the clearance space, the fact will immediately become evident on projecting the point $r'''$ of the detailing plane back to the side and end views. If the point $r'$ in the side view falls below the horizontal projection of $c'$, it will evidently fall below the point $e$ in the end view, and the fouling of the clearance diagram will be apparent. In such a case the kneebrace must be relocated, working in the back plane.

To show the top plane of the portal, project the top strut up from the portal plane as shown in Fig. 2. The thickness of the portal ($y$) is to be found thus (see Fig. 4):

$$on = v\tan\kappa$$

$$z = \sqrt{v^2 + on^2}$$

or,

$$z = \frac{v}{\cos\kappa}$$

$$y = z\sin\phi$$

$$rq = z\cos\phi$$

angle $\phi$ being obtained from formula (8),

Check: $z = \sqrt{y^2 + rq^2}$

SHOP DETAIL DRAWING.—The shop detail, Fig. 3, will consist simply of an enlarged and more complete and accurate reproduction of the projected sketch (in portal plane) just described.

The depth of the portal along end-posts ($g'''j'''$ in Fig. 2), the location of the kneebraces ($j'''c'''$, $j'''e'''$, and $d'''b'''$, $b'''f'''$) and the location of the web members may be scaled from the smaller drawing, but all other dimensions and angles must be accurately figured therefrom. Side elevations of the kneebraces and top and bottom struts should be shown, as also views of the connections to the truss. The amount of detail shown will depend upon the individual shop practice. The methods of calculating the main dimensions are illustrated in the following calculations for the example shown in Figs. 2 and 3.

The angle at which to bend the hitch-plates is $90° - \delta$. This also is the angle at which to bend any other piece connecting the portal plane with the

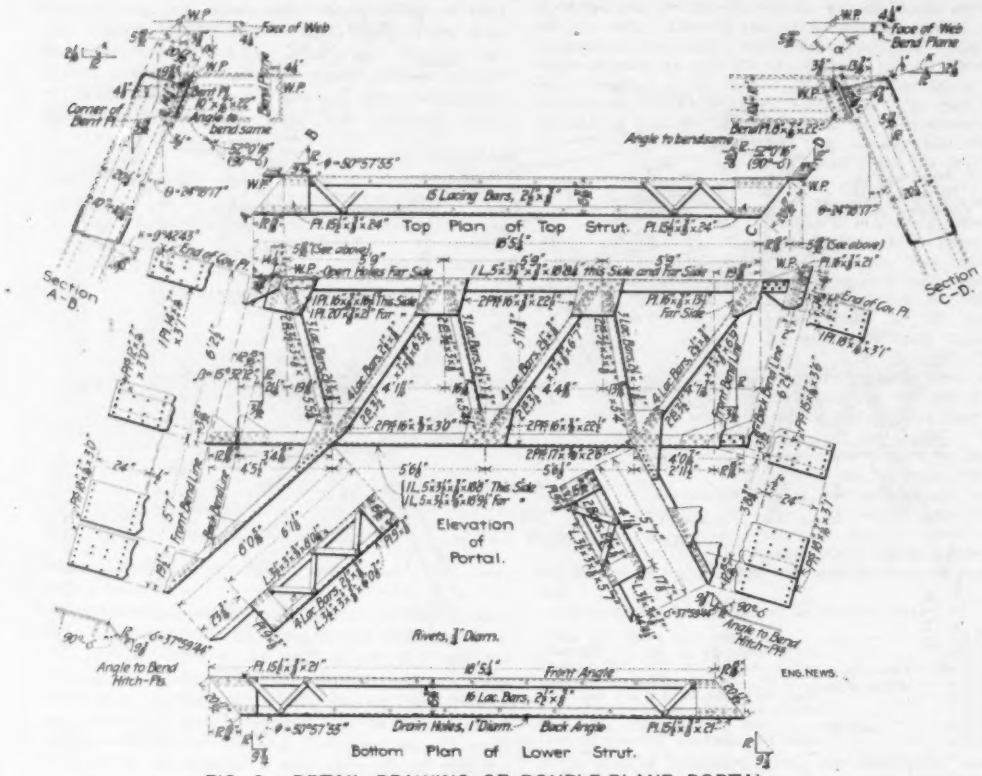



FIG. 3. DETAIL DRAWING OF DOUBLE-PLANE PORTAL.
[Rivet-spacing and minor dimensions omitted.]

plane of the truss. The angle to bend any angles connecting the top (or bottom) plane of the portal with the side of the truss $= 90° - \lambda$.

The data for the example are:

| | Ft. | Ins. |
|---|---|---|
| Depth of truss ($d$) | 31 | 0 |
| Horizontal projection of end-post ($p$) | 14 | 0 |
| Skew ($s$) | 12 | 0 |
| Distance between trusses ($c$ to $c$) | 16 | 1 |
| Distance between bend-lines ($w$) | 14 | 0 |
| Depth of end-posts between hitch-plates ($v$) | 1 | 8¾ |

From these are found the values of the angles and lengths as follows:

$$\tan \alpha = \frac{12 \text{ ft.}}{14 \text{ ft.}}$$

$\log 12 = 1.07918$
$-\log 14 = 1.14613$
$\log \tan \alpha = 9.93305$
$\alpha = 40° 36' 04''$

$$\tan \theta = \frac{14 \text{ ft.}}{31 \text{ ft.}}$$

$\log 14 = 1.14613$
$-\log 31 = 1.49136$
$\log \tan \theta = 9.65477$
$\theta = 24° 18' 17''$

$\sin \beta = \sin \alpha \sin \theta$
$\log \sin \alpha = 9.813440$
$\log \sin \theta = 9.614464$
$\log \sin \beta = 19.427904$
$\beta = 15° 32' 12''$

Similarly

$\tan \delta = \tan \alpha \cos \theta$
$\delta = 37° 59' 44''$

$\tan \kappa = \sin \delta \tan \beta$
$\kappa = 9° 42' 43''$

$\epsilon = 90° + \kappa - \theta$
$99° 42' 43''$
$- 24° 18' 17''$
$\epsilon = 75° 24' 26''$

$$\cos \phi = \frac{\sin \delta \sin (\epsilon + \theta)}{\cos \beta}$$

$\epsilon = 75° 24' 26''$
$\theta = 24° 18' 17''$
$99° 42' 43''$

$\sin 99° 42' 43'' = \cos 9° 42' 43''$
$\log \sin \delta = 9.789299$
$\log \cos 9° 42' 43'' = 9.993731$
$\text{colog} \cos \beta = 0.016167$
$\log \cos \phi = 9.799197$
$\phi = 50° 57' 55''$

The length of portal strut is:
$(14 \text{ ft.})^2 = 196.0$
$(12 \text{ ft.})^2 = 144.0$
$\text{Length}^2 = 340.0$
$\text{Length} = 18 \text{ ft. } 5¾ \text{ ins.}$

The distance between bend-lines in portal-plane is $x = v \sin \delta$, where $v = 1$ ft. 8¾ ins.:
$\log 1 \text{ ft. } 8¾ \text{ ins.} = 0.22724$
$\log \sin \delta = 9.78929$
$\log x = 0.01653$
$x = 1 \text{ ft. } 0\frac{1}{8} \text{ in.}$

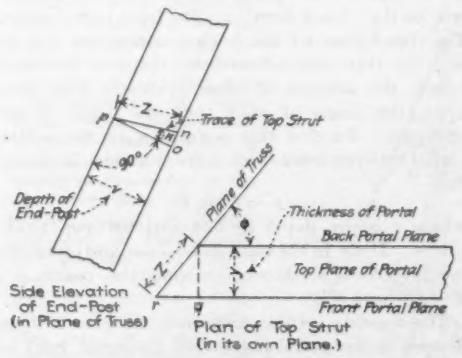

Trace of Top Strut
Depth of End-Post
Plane of Truss
Thickness of Portal
Back Portal Plane
Top Plane of Portal
Front Portal Plane
Side Elevation of End-Post (in Plane of Truss)
Plan of Top Strut (in its own Plane.)

Fig. 4. Diagram for Calculation of Portal Thickness.

The thickness of portal $y$, is found as per Fig. 4:
$on = v \tan \kappa$
$\log 1 \text{ ft. } 8¾ \text{ ins.} = 0.227244$
$\log \tan \kappa = 9.233365$
$9.460609$
$on = 3\frac{1}{16} \text{ ins.}$
$(3\frac{1}{16} \text{ ins.})^2 = 0.083557$
$(1 \text{ ft. } 8¾ \text{ ins.})^2 = 2.8477$
$2.931257$
$z = 1 \text{ ft. } 8\frac{1}{16} \text{ ins.}$

$rq = z \cos \phi$
$\log z = 0.23356$
$\log \cos \phi = 9.79919$
$0.03275$
$rq = 1 \text{ ft. } 0\frac{1}{16} \text{ in.}$

$y = z \sin \phi$
$\log z = 0.23356$
$\log \sin \phi = 9.89029$
$10.12385$
$y = 1 \text{ ft. } 3\frac{3}{16} \text{ ins.}$

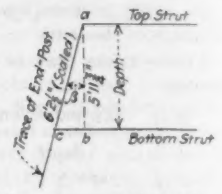



Fig. 5. Diagram for Calculation of Portal Depth.

The depth of the portal (Fig. 5) is computed from the depth along post, scaled from the layout:
$ab = ac \cos \beta$
$\log 6 \text{ ft. } 2¾ \text{ ins.} = 0.79298$
$\log \cos \beta = 9.98383$
$10.77681$
$ab = \text{depth} = 5 \text{ ft. } 11¾ \text{ ins.}$

The length of forward kneebrace (Fig 6) is computed from the scaled depth along post and reach

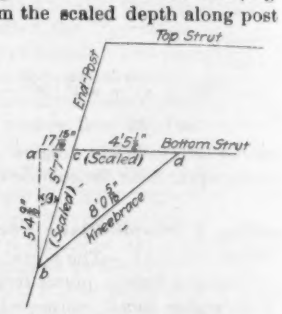



Fig. 6 Diagram for Calculation of Kneebrace Length.

along portal. The depth in plane of portal is first found:
$ab = bc \cos \beta$
$\log 5 \text{ ft. } 7 \text{ ins.} = 0.74689$
$\log \cos \beta = 9.98383$
$0.73072$
$ab = 5 \text{ ft. } 4\frac{5}{16} \text{ ins.}$

The horizontal departure of the post on the height of the brace is:
$ac = bc \sin \beta$
$\log 5 \text{ ft. } 7 \text{ ins.} = 0.74689$
$\log \sin \beta = 9.42790$
$0.17479$
$ac = 1 \text{ ft. } 5\frac{1}{16} \text{ ins.}$

The reach along the portal being scaled as 4 ft. 5¼ ins., the total horizontal length is 5 ft. $11\frac{7}{16}$ ins., and the length of brace is:
$(5 \text{ ft. } 11\frac{7}{16} \text{ ins})^2 = 35.4397$
$(5 \text{ ft. } 4\frac{5}{16} \text{ ins.})^2 = 28.9466$
$bd^2 = 64.3863$
$bd = 8 \text{ ft. } 0\frac{5}{16} \text{ in.}$

The length of the back kneebrace is obtained in similar manner.

**Detailing A Single-Plane Portal.**

MAKE-UP OF PORTAL.—The portal described will consist of top and bottom struts of $T$ section connected by single-angle lacing; the kneebraces will consist of plate-and-angle brackets. The whole will be connected to the truss by a bent plate and two angles riveted to the side of the end-post on the center-line of the webs. The top strut however will be placed high enough to clear the hip and will be bent and connected to the cover-plate of the top chord.

PRELIMINARY LAYOUT.—As in the preced-

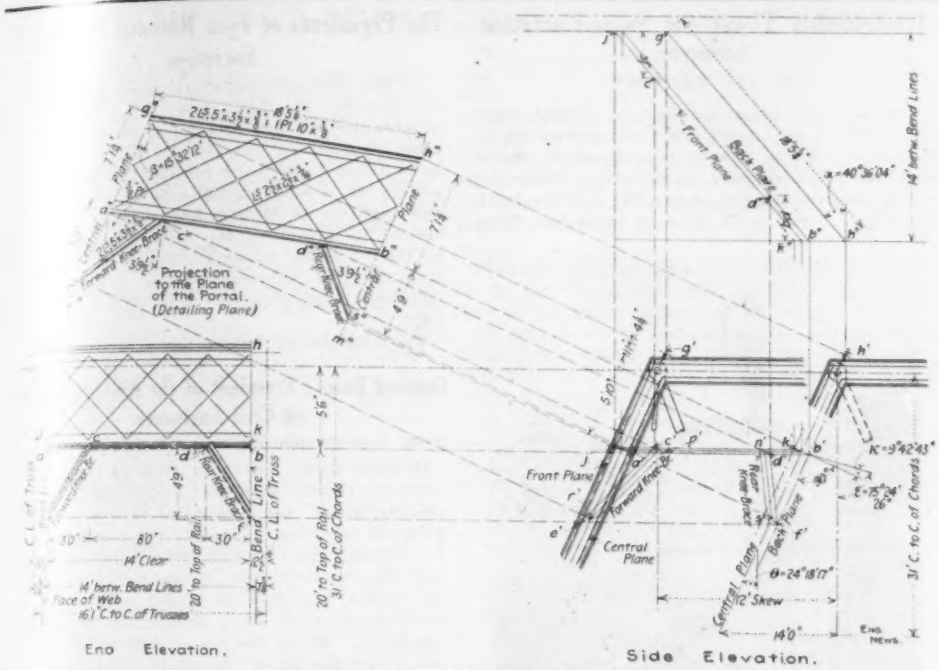



FIG. 7. PRELIMINARY LAYOUT FOR SINGLE- PLANE PORTAL.

ing example a preliminary layout is first made to locate dimensions which depend upon clearance requirements. End, side and horizontal projections of the end of the span should be drawn, with the clearance-diagram or lines in each. The working width of the span ($w$ in the formulas) is the distance between the bend-lines of the connection plates, or about 9¼ ins. less than the distance between faces of web plates of the end posts or top-chords. The skew $s$ is the advance of one end-pin beyond the other. The depth $d$ and the distance $BE = p$ are the regular pin-to-pin distances.

The top line of the portal should be located high enough to allow the bent angles of the top strut to clear the top chord.

Draw in the lower line of the portal and knee-braces so as to hug the clearance diagram as closely as desired. Here note that the portal has actually a thickness of about 10¾ ins. (the width out to out of strut) and that the lowest line of the portal strut will be in the back plane, the lowest line of the forward knee-brace (except where skew is small) will be in the front plane, and the lowest line of the rear kneebrace will be in the back plane of the portal. The proper respective planes must be used in projecting.

To determine the traces of these planes on the end posts, determine the distance $z$ (Fig. 9) from

$$z = \frac{y}{\sin \phi} = \frac{10\frac{3}{4}}{\sin \phi}$$

the angle $\phi$ being obtained from eq. (8). Angle $\kappa$ may be obtained from eq. (10) and the traces of the front and back planes drawn on the (working) side of the end post as shown. (The distance $z$ need only be obtained approximately in this example.) If the width of the kneebraces is less than the width of the portal struts, a separate calculation will be required for them.

Now in the layout, Fig. 7, project the points $a$, $b$, $e$ and $f$ to $a'$, $b'$, $e'$ and $f'$, each to its proper plane. In this side view draw $b'\ k'$ and $a'\ j'$ at the angle $\kappa$ with the perpendicular to the line of end-post, join $j'\ k'$ and project to $j\ k$ and $j''\ k''$.

To locate the kneebraces, lay off the distances $jc$ and $kd$ on the horizontal plane, locating the points $c''$ and $d''$, and project down to $c'$ and $d'$. Join $e'\ c'$ and $d'\ f'$ and complete this view of the kneebraces, noting that $c'\ p'$ and $d'\ n'$ are perpendicular to the end-posts. Project to the end view.

To project to the portal plane (the detailing plane), project $h'$ and $g'$ perpendicular to the end-posts and take a line $h'''\ g''' = g''\ h''$ ($g''\ h''$ must be calculated from distance $ab$ and the skew). Draw $g'''\ t'''$ and $h'''\ m'''$ parallel to the end-posts, these will be the "bend-lines" of the portal and will be in the "central" plane of the portal. (It will not be necessary to locate the traces of the "front" and "back" planes on this view because we have to work only in the central plane). Continue the projection as shown, locating the points $r'''$, $s'''$, $c'''$ and $d'''$.

The trussing system may now he drawn in as desired in the portal plane and projected back to the end view to give the finished appearance of the portal.

If, as before noted, it happens that the skew is small, there is a likelihood that the lowest line of the forward kneebrace may be in the back portal plane, as is the case in a square bridge. If this is so, and there is danger of the forward kneebrace encroaching on the clearance space, the fact will immediately become evident on projecting the

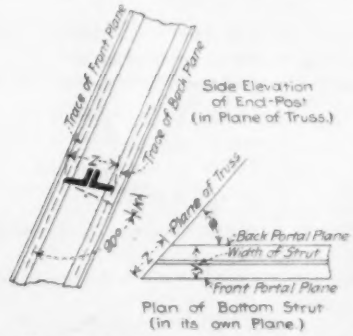

Trace of Front Plane
Trace of Back Plane
Side Elevation of End-Post (in Plane of Truss.)
Plane of Truss
Back Portal Plane
Width of Strut
Front Portal Plane
Plan of Bottom Strut (in its own Plane.)

Fig. 9. Diagram for Approximate Location of Front and Back Planes to Fix Clearance Limits.

completed kneebrace of the side view back to the end view. If the point $r'$ in the side view falls below the horizontal projection of $e'$, it will evidently fall below the point $e$ in the end view and the fouling of the clearance diagram will be apparent. In such a case the kneebrace must be relocated, working in the back plane.

THE SHOP DETAIL DRAWING.—The shop detail will consist simply of an enlarged and more complete and accurate view of the projected sketch just described. The depth of the portal along the end-post, $g'''\ a'''$, the location of the knee-braces, $a'''\ c'''$, $a'''\ r'''$ and $d'''\ b'''$, $b'''\ s'''$, and the location of the web members may be scaled from the smaller drawing, but all other dimensions and angles must be accurately figured from these distances and the dimensions of the trusses. Side elevations of the kneebraces and top and bottom struts should be shown, as also views of the connections to the truss. The amount of detail shown will depend upon the individual shop practice. The methods of calculating the main dimensions are illustrated in the following:

The angle at which to bend the hitch-plates is $90° - \delta$. This also is the angle at which to bend any member connecting the portal plane with the plane of the truss.

The bend angle for any member connecting the top (or bottom) plane of the portal with the side of the truss is $90° - \lambda$.

If the top-strut sits directly on the top-chord,

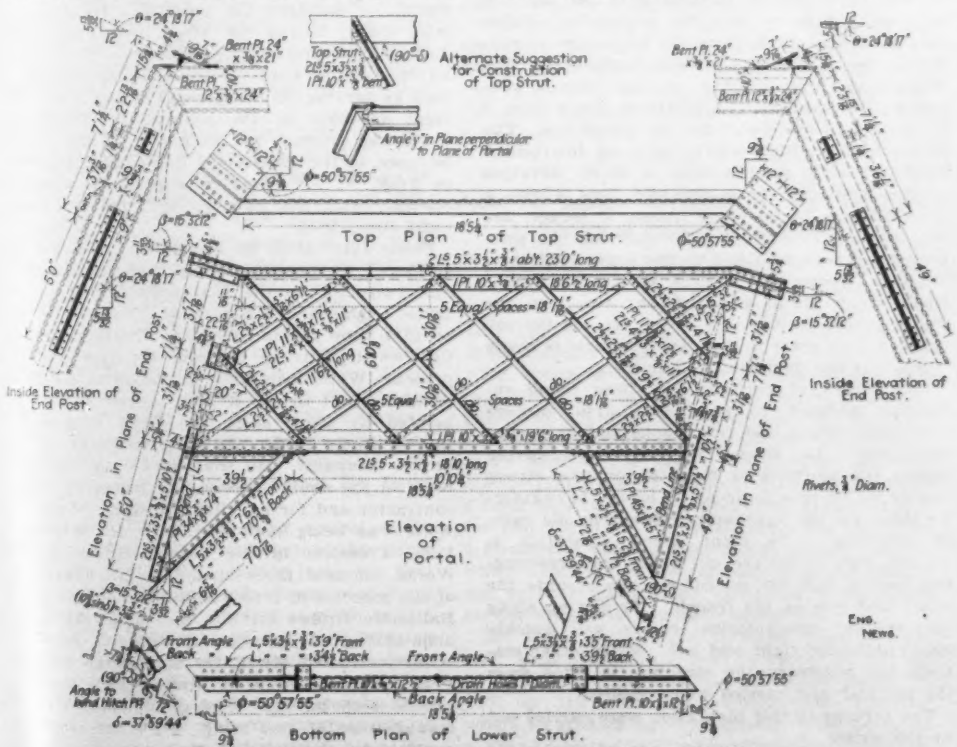

Top Plan of Top Strut.
Elevation of Portal.
Bottom Plan of Lower Strut.
Alternate Suggestion for Construction of Top Strut.
Inside Elevation of End Post.
Elevation in Plane of End Post.
Rivets, ¾" Diam.
Eng. News.

FIG. 8. DETAIL DRAWING OF SINGLE-PLANE PORTAL.
[Rivet-spacing and minor dimensions omitted.]

or is otherwise placed so that its axes are in vertical and horizontal planes (see alternate sketch in Fig. 8), the angle at which to bend the gussets connecting it with the plane of the portal = $\gamma$.

The data for the example are the same as used in the previous example, except for the width of strut:

| | Ft. | Ins. |
|---|---|---|
| Depth of truss ($d$) - - - | 31 | 0 |
| Horizontal projection of end-post ($p$) | 14 | 0 |
| Skew ($s$) - - - - | 12 | 0 |
| Distance between trusses, $c$ to $c$ - | 16 | 1 |
| Distance between bend-lines ($w$) - | 14 | 0 |
| Width of strut ($y$) - - - .. | | 10½ |

The angles calculated therefrom are the same as before, viz:

$$\alpha = 40^\circ\ 36'\ 04''$$
$$\theta = 24^\circ\ 18'\ 17''$$
$$\beta = 15^\circ\ 32'\ 12''$$
$$\delta = 37^\circ\ 59'\ 44''$$
$$\kappa = 9^\circ\ 42'\ 43''$$
$$\epsilon = 75^\circ\ 24'\ 26''$$
$$\phi = 50^\circ\ 57'\ 55''$$

The length of portal strut is found from the width and skew to be:

$$(14\text{ ft.})^2 = 196.0$$
$$(12\text{ ft.})^2 = 144.0$$
$$\text{Length}^2 = 340.0$$
$$\text{Length} = 18\text{ ft. } 5\tfrac{1}{4}\text{ ins.}$$

The distance between the traces of front and back planes on the end-post are found as per Fig. 9:

$$z = \frac{y}{\sin\phi} = \frac{10\tfrac{1}{2}\text{ ins.}}{\sin\phi} = \frac{10.5}{.7768} = 13\tfrac{1}{2}\text{ ins.}$$

Distance between planes = $13\frac{1}{2}\cos\kappa = 13\frac{5}{16}$ ins.

The depth of portal is found as in Fig. 5:

$ab = ac\cos\beta$, $ac$ being scaled as 7 ft. 1¼ ins.

$$\log 7\text{ ft. } 1\tfrac{1}{4}\text{ ins.} = 0.85151$$
$$\log\cos\beta = 9.98383$$
$$10.83534$$
$$ab = 6\text{ ft. } 10\tfrac{5}{8}\text{ ins.}$$

The length of forward kneebrace is found as in Fig. 6:

Horizontal departure, $ac = bc\sin\beta$, $bc$ being scaled as 5 ft.

$$\log 5\text{ ft.} = 0.69897$$
$$\log\sin\beta = 9.42790$$
$$10.12687$$
$$ac = 1\text{ ft. } 4\tfrac{1}{16}\text{ ins.}$$

Depth in plane of portal $ab = bc\cos\beta =$

$$\log 5\text{ ft.} = 0.69897$$
$$\log\cos\beta = 9.98383$$
$$10.68280$$
$$ab = 4\text{ ft. } 9\tfrac{13}{16}\text{ ins.}$$

The total horizontal run of the kneebrace then is 1 ft. $4\frac{1}{16}$ ins. plus 3 ft. 9¼ ins. (scaled reach along strut) = 5 ft. $1\frac{9}{16}$ ins., and the true length of kneebrace is:

$$(5\text{ ft. } 1\tfrac{9}{16}\text{ ins.})^2 = 26.3190$$
$$(4\text{ ft. } 9\tfrac{13}{16}\text{ ins.})^2 = 23.2103$$
$$49.5293$$
$$b\overline{d} = 7\text{ ft. } 0\tfrac{7}{16}\text{ in.}$$

The length of the back kneebrace is obtained in manner similar to above.

STEEL RAILS IN CANADA are manufactured at Sydney, N. S., by the Dominion Iron & Steel Co., and of Sault Ste. Marie, Ont., by the Algoma Steel Co. All the rails made at the Sydney works are of basic open-hearth steel. The ingots are 18 × 21 ins., and in reducing from the ingot to the finished rail the steel makes 30 passes through the rolls. At the Sault Ste. Marie works, 75% of the rails are of acid Bessemer steel and 25% of basic open-hearth steel. The ingots are 16 × 17 ins., and the steel makes 28 passes through the rolls to produce the finished rail. The above particulars were given in a paper read before the Canadian Railway Club by Mr. F. P. Gutelius, M. Am. Soc. C. E., General Superintendent of the Lake Superior Division of the Canadian Pacific Ry. He stated also that the capacity of these two steel mills is about equal to the requirements for new rails in Canada.

## Triangulation Tower for Sugar-Plantation Surveys.

By GEO. FASTING.*

The Chaparra Sugar Co. has the largest sugar plantation in the world, and the magnitude of the enterprise may be indicated, perhaps, by noting some of the plantation equipment. There are eleven locomotives and about 600 cars for hauling cane. There is 72 miles of track laid down

A Triangulation Tower for Sugar-Plantation Surveys.

in the field. The area planted with cane is supposed to be about 40,000 acres. The mill grinds some 4,000 tons of cane per day.

This company desired to have their land surveyed, but on account of the magnitude of the work some previous local practices had to be abandoned. Surveying of the Cuban sugar plantations is generally done when planting the seed or after the cane is cut, as then everything is visible. On account of the time required to complete the surveys it was necessary that the work should not be interrupted by the growing crop.

A tower was constructed, for the field triangulation, high enough to allow the instrumentman to look over the cane. It had to be made strong enough to withstand careless handling, but the material had to be light for portability. Cedar was selected. A platform 3½ ft. square is supported by four studs braced horizontally and diagonally. The bracing on one side is disposed as a ladder. The platform has a hole, 1 ft. square, in the center for the plumb line. The frame is 8 ft. high which, with an instrument height of 5 ft., gives a total of 13 ft. elevation of the telescope above ground. This allows a good horizon as the cane leaves, if longer, are bent down. Two handles for carrying the platform have been attached to the lower horizontal bracing. These handles are so far down that when the platform is carried by two men the legs will clear trunks, low grass, etc. If the soil is soft or the grass is high, the platform is easily carried on the shoulders of four men.

This design of platform has been found especially adapted to sugar-plantation surveys with their tracks and side tracks laid in several directions. As shown in the accompanying figure, the platform is mounted on two strong boards nailed to a handcar. The car is counterweighted for the overhanging tower by old rails. On arriving at a point where a station is wanted, two struts are put under the overhanging boards and the instrumentman mounts the tower and sets up his transit. By driving along the tracks, triangulation points are quickly shot out to the right and left. When other stations are necessary the structure is lifted from the handcar and carried where desired.

The surveys of this plantation were carried out by the writer.

*Chaparra Sugar Co., Chaparra, Cuba.

## The Presidents of Four National Engineering Societies.

As has been our custom for some sixteen years we present in this issue the portraits and biographies of the presidents of three of the great engineering societies in this country, and have added thereto the president of the national society of a neighboring country. The American Institute of Mining Engineers this year re-elected its president, Mr. John Hays Hammond, so that it is not necessary for us to repeat the biography of that gentleman published with last year's presidents in our issue of June 23, 1908.

The biographies follow:

### Onward Bates: President of the American Society of Civil Engineers.

By D. J. WHITTEMORE, Past-President Am. Soc. C. E.

Onward Bates was born Feb. 24, 1850, in St. Charles County, Mo. Mr. Bates comes of good English stock, his ancestors having settled in Virginia previous to the War of the Revolution. His grandparents moved from Virginia to Missouri in the early part of the last century, and his family has been identified with that state since the time it was a part of the Territory of Louisiana. He is the son of Barton Bates, who was Chief Justice of the State of Missouri, and the grandson of Edward Bates, Attorney-General during the first term of President Lincoln. His mother, before marriage, was Caroline Matilda Hatcher. His boyhood, until he was 15, was spent in St. Louis and on the farm in St. Charles Co., where he attended the usual country schools.

On the first day of March, 1865, he entered the Fulton Iron Works, St. Louis, Mo., as an apprentice, and learned the trade of pattern making. About August, 1868, he attracted the attention of the late Col. C. Shaler Smith, who was building a bridge over the Missouri River at St Charles. Col. Smith asked the proprietor of the Fulton Iron Works to cancel the apprenticeship and turn Mr. Bates over to him. He served Col. Smith on the St. Charles bridge for about one year, being employed first as a draftsman and then as inspector of the iron work for the approaches to the bridge.

At that time Mr. Bates was offered a position with Capt. Wm. S. Nelson, who had the contract for building the iron caissons for the piers of the St. Louis Bridge, and with the consent of Col. Smith he accepted the position. He remained with Capt. Nelson for about two years, until July, 1871, acting as shop foreman and laying out all of the iron work for the caissons himself, as well as serving in the general capacity of principal assistant to the contractor. When this work was finished, by the advice of Col. Smith, he went to the Rensselaer Polytechnic Institute, at Troy, N. Y. There he studied, as a special student, with the class of 1875 for two years, until June, 1873.

From July, 1873, to November, 1874, he was employed by Col. Smith as Assistant Engineer and Inspector on the east approach of the St. Louis Bridge and other works. Col. Smith was at that time President of the Baltimore Bridge Co., which had the contract for this east approach. While inspecting this work at the shops of the Detroit Bridge & Iron Works, he was appointed by Capt. Eads, the Chief Engineer of the St. Louis Bridge, as shop inspector for the bridge company. He thus served on the same work in the double capacity of inspector for the contractor and for his client as well. While this work was being manufactured, Mr. Willard S. Pope, President of the Detroit Bridge & Iron Works, thought there should be an adjustment of the schedule of prices paid his company by the Baltimore Bridge Co. for the metal work, and upon taking this question up with Col. Smith the latter instructed Mr. Bates to arrange with Mr. Pope a new schedule of prices which would be fair to both parties. The circumstances of the manufacture of this metal work are worth recording as showing, at that period, the confidence and respect existing between engineers,

when one inspector could serve both parties and when the contract prices could be disregarded and readjusted to secure equity.

Mr. Bates remained with the Baltimore Bridge Co. until the east approach of the St. Louis Bridge was completed, about November, 1874. At that time the general business in the country was dull and there was very little construction in progress. The Cincinnati Southern Ry. was being put under way, and Mr. Bates entered the service of that road as draftsman, under Mr. G. Bouscaren, Principal Assistant to Mr. Thos. D. Lovett, Chief Engineer of the road. Mr. Chas. L. Strobel was Mr. Bates' immediate superior in the office. He was then promoted by Mr. Bouscaren to be inspector of iron bridges and trestles, and served in that capacity until about June, 1877, when the Cincinnati Southern Ry. had exhausted its first appropriation and for want of funds reduced its engineering staff.

Mr. Bates then entered the service of the Chicago, Milwaukee & St. Paul Ry. Co., under Mr. D. J. Whittemore, Chief Engineer, as inspector of iron bridges. While inspecting the material at the shops for the Kilbourn Bridge over the Wisconsin River, the contractor's superintendent lost his leg in an accident. Mr. Bates was called to the site and took charge for the contractor as well as for the railway company, completing what, at that time, was considered a difficult piece of construction, with satisfaction to both interests.

He remained in the service of Mr. Whittemore until March, 1878, when he was released in order to go to Australia. He was sent out there by Col. C. Shaler Smith and Mr. William Sellers, President of the Edge Moor Iron Co., of Wilmington, Del., as their representative. He remained in Australia for over three years, returning to the United States in August, 1881. Mr. Bates built in Australia a bridge over the Shoalhaven River, for the New South Wales Government, under the direction of Mr. W. C. Bennett, M. Inst. C. E., and some iron viaducts on the Adelaide & Nairne Ry., under Mr. H. C. Mais, M. Inst, C. E., Engineer-in-Chief of the South Australian Railways. Also a swing bridge for the Adelaide Dock Co., under Mr. Geo. Chamier, M. Inst. C. E., Chief Engineer. The Adelaide and the Nairne viaducts have recently been the subject of a paper in the "Transactions of the Institution of Civil Engineers," in which they are favorably described at the present time.

On his return to the United States, he was employed in the office of Col. Smith for some time, and then became President of the Pittsburg Bridge Co. He remained with this company until March, 1884, when he again served Col. Smith as assistant in his practice of Consulting Engineer, and was employed upon several important works.

For about one year, from April, 1886, to April, 1887, he was engaged in mining in Mexico.

From May 1, 1887, to Feb. 1, 1888, he was in the service of the Edge Moor Iron Co., of Wilmington, Del. On Feb. 1, 1888, he entered the service of the Chicago, Milwaukee & St. Paul Ry. Co., as Engineer and Superintendent of Bridges and Buildings. He remained with this company for 13 years, until March, 1901.

The writer believes that this period of 13 years of Mr. Bates' work deserves more than passing notice. In 1888, the Chicago, Milwaukee & St. Paul Ry. Co. wisely decided that a department of Bridges and Buildings should be instituted, and that the work pertaining thereto should be placed in the direct charge of a competent engineer. Fortunately for the company, Mr. Bates received the appointment.

To make mention of the many special works brought under his charge would extend this paper beyond reasonable limits. Suffice it to say that some idea of the volume and importance of the work brought to his department may be had in that over 100 miles in the aggregate of bridging of all classes required his attention. A large portion was constructed of wood, gradually requiring renewal, either in kind, or reconstruction in metal. Over 13,000 culverts, aggregating in length over 100 miles, also demanded his attention. In addition, there were shops and other buildings necessary for the convenient operation of about 6,000 miles of railway line.

Through his marked ability to organize, to design and to economically construct, his work was carried on for 13 years in a manner that commended the approval not only of the management of the railway company, but of every individual either remotely or intimately connected with him in his great work. When he left the service, he left none but friends, all regretting his leaving, and none more so than the writer.

From the close of his service with the C., M. & St. P. Ry. Co. in 1901 until 1907, he was President of the Bates & Rogers Construction Co.

At present he is without any stated employment, announcing that he has for so long a period been so busy that he intends a course of study in those departments of human knowledge from which he has been debarred by reason of his work. It can be taken for granted, however, that he will never lose his keen interest in all matters of engineering or in those who are of his profession.

Mr. Bates always regretted that he did not take a complete course of instruction at the Rensselaer Polytechnic Institute instead of only two years. It therefore gave him special pleasure in 1896 to receive from the University of Wisconsin the Honorary Degree of Civil Engineer.

Mr. Bates has often most successfully aided his associates over many exceedingly difficult problems of construction, and contributed largely of his share to civilization in his pursuit of that profession that has for its object the conservation of time, power and matter for the purposes of man.

He became a member of the American Society of Civil Engineers on Jan. 4, 1882, and was Vice-President of the Society in 1906-7. He is a member of the Institution of Civil Engineers (of Great Britain), and Past-President of the Western Society of Engineers.

In politics Mr. Bates is a Democrat, with the reservation that he will not support any men or measures which he does not approve. His political creed may be summed up in the words "Obedience to the law." Mr. Bates is interested in religious and philanthropic work: for twelve years he has been an Elder in the Presbyterian Church.

His home life is most happy, doubly so in the fact that in 1892 he married Virginia Castleman, daughter of the late Judge Samuel M. Breckinridge, a woman of rare culture and refinement, and of sincere religious convictions.

The writer desires to assure the members of the profession that they have deservedly conferred upon Mr. Bates the highest honor that can be awarded a civil engineer in electing him President of the American Society of Civil Engineers.

## Jesse M. Smith: President of the American Society of Mechanical Engineers.

By AMBROSE SWASEY, Past-President Am. Soc. M. E.

The American Society of Mechanical Engineers, at its election in December, chose as its President for the ensuing year, Mr. Jesse Merrick Smith, of New York City.

Mr. Smith is an engineer of wide and varied experience, and, of late years, has won distinction as an expert in Patent Causes. He has been a member of the Society since the second year of its existence, is now a life member and has always taken a deep interest in its affairs. For a term he served on the Council as Manager, and for two terms as Vice-President. He has been a member of various committees, notably the one which drafted the present excellent constitution and by-laws, and has just completed a five years' service on the membership committee.

Mr. Smith was born at Newark, Ohio, in 1848, and, with his father's family, moved to Detroit in 1862. His engineering education began in 1865 at the Rensselaer Polytechnic Institute, where he studied for three years. Then he spent a year traveling in Europe, after which, with almost no previous knowledge of French and with less than three months' preparation, he passed the severe entrance examinations of l'Ecole Centrale des Arts et Manufactures of Paris, and, although he entered near the foot in a class of two hundred, he graduated in 1872 among the first ten, taking his degree as Mechanical Engineer. These years of study in Paris were among the troublous times of the Franco-Prussian War which culminated in the Commune.

After his graduation, he traveled for three months among the iron works and machine shops of England, and, during his vacations, he had already visited many manufacturing plants in France, Germany and Belgium, besides finding time to attend lectures in a technical school in Berlin, where he studied under the famous Dr. Franz Reuleaux.

Mr. Smith returned to the United States in 1872, and, although it was a year of financial depression, he soon coupled his splendid engineering training with his native aptitude for constructive work, and began in central Ohio the erection of blast furnaces for smelting iron from the lean native ores by the use of raw bituminous coal. This was a new industry in that locality and involved the opening and necessary surveys for coal and ore mines, as well as the designing of handling machinery and the laying out and constructing of railroads from the mines to the furnaces.

In 1880 he returned to Detroit where he opened an office as Consulting Engineer. At that time lighting by electricity was just coming into use, and Mr. Smith entered the field as a pioneer in the installation of electric lighting plants throughout the central West. In 1883 he designed and constructed a high-speed center-crank steam engine, controlled by a governor built in the fly-wheel. In this governor were embodied the essential features of the modern inertia governor and it gave remarkably close regulation of speed. The first engine successfully drove a 40-arc light Brush dynamo.

During the years 1884-6 he designed and installed a number of incandescent electric light plants, among them one of 1,000 lights for the Stillman Hotel at Cleveland, O. Two of his improved engines were used in this plant, connected by clutches to opposite ends of the same shaft and driving three Weston dynamos. This hotel is believed to have been the first in this country to be lighted exclusively and continuously by electricity furnished from its own plant.

In addition to designing and erecting electric railway plants, he also designed many special machines in several different lines of manufacture. In some of these machines the most intricate mechanism was required, yet so well were the machines thought out and so admirably designed that they proved to be not only highly efficient, but most practical in doing the work for which they were intended.

The breadth of his technical education, his keen perception of the principles involved in the solution of mechanical problems, and the great variety of his practical engineering achievements, especially fitted him to testify as an expert in litigation growing out of patents. As early as 1883, he began to be called upon for expert testimony in the United States Courts, and so successful was he in this branch of his profession that his practice in the Courts gradually displaced his work as Consulting Engineer until 1898, when he moved to New York City to devote his time exclusively to the giving of expert testimony in Patent Causes.

Mr. Smith is a charter member of the American Institute of Electrical Engineers. He is also a member of the Société des Ingénieurs Civils de France; the Association des Anciens Elèves de l'Ecole Centrale des Arts et Manufactures; the Detroit Engineering Society; the Society for the Advancement of Science; the National Geographical Society; the Engineers' Club of New York, and the Ohio Society of New York.

Mr. Smith was a member of the party of American Engineers who visited Europe in 1889, as well as of the party of 1900. He has traveled extensively abroad and has a large acquaintance among the members of the engineering profession in Europe, as well as in this country. He is especially interested in the achievements of

others, is a close observer and in every way a most interesting and enjoyable traveling companion.

## Louis A. Ferguson: President of the American Institute of Electrical Engineers.

By B. E. SUNNY*, M. Am. Inst. E. E.

Louis Aloysius Ferguson is one of the leading electrical engineers of the present day, and has exerted a broad influence upon the development of the art, particularly in regard to the commercial development of electric lighting. He was born in Dorchester, Mass., on Aug. 19, 1867, and received his early education in the Boston public schools. He successfully passed his examination for entrance to the U. S. Military Academy at West Point, but his family induced him to abandon the plan of following a military career.

Upon his graduation from the Dorchester high school, in 1884, his tastes for engineering and technical pursuits led him to take up the study of electrical engineering in the Massachusetts Institute of Technology. His four years' course of study was brought to a conclusion with a thesis involving many original and novel experiments to determine the relation between candle-power, voltage and energy consumed in incandescent lamps. His investigations in the then early days of incandescent lighting, when exact knowledge on this subject was very meager, attracted considerable attention and received much favorable comment. He graduated from the Institute in 1888, with a degree of Bachelor of Science in Electrical Engineering.

As a result of his line of study, he naturally turned to the field of electric lighting. He began his professional and business career by entering the underground distribution department of the Chicago Edison Co., in 1888. In 1890, he was appointed Electrical Engineer, and as such, was given charge of all the electrical engineering and operating work of the company. Three years later his duties were enlarged to include the supervision of all soliciting and contracting. In this field he successfully negotiated long-term contracts with some of Chicago's largest mercantile establishments. In 1897, Mr. Samuel Insull, President of the Chicago Edison Co., appointed him to the position of General Superintendent, and a year later he was also made General Superintendent of the Commonwealth Electric Co. He was elected Second Vice-President of both companies in 1902. Upon the consolidation of these companies under the name of the Commonwealth Edison Co., in 1907,* he was made Second Vice-President of the new corporation, which is now one of the largest and most rapidly growing electric lighting and power companies in the world.

As an indication of the magnitude of the developments with which Mr. Ferguson has been connected, it may be noted that when, in 1888, he entered the employ of the Chicago Edison Co., the original Adams St. station with its four 200-HP. non-condensing engines and belted direct-current generators was just nearing completion. During the 20 years that Mr. Ferguson has been either in direct or in general charge of the electrical engineering and operating work of this company, its physical properties have been developed to large proportions. Instead of one station with a capacity of only 600 KW., there are to-day three main generating stations with a combined capacity of 150,000 KW. There is also an underground high-tension transmission system of approximately 400 miles, supplying 33 sub-stations (aggregating 75,000 KW.) owned by the company and 15 sub-stations (aggregating 80,000 KW.) owned principally by railway companies. The gross earnings of this company in 1888 were approximately $62,000, as compared with $9,500,000 for the year ending Sept. 30, 1908.

The engineering and commercial growth of the Commonwealth Edison Co. has been in the direction of a universal electric power system, capable of supplying all electric power demands, large or small and of whatever nature, and Mr. Ferguson has been intimately associated with the engineering and general policy that has resulted in the existing comprehensive electric-power system of this company. To him belongs the credit of being the first central-station engineer in this country to recommend the system of generating three-phase alternating current with high-tension transmission lines to sub-stations containing rotary transformers for converting from alternating current to direct current for general distribution. It is largely by reason of the general adoption of this system that the great electric-power developments in the large cities of this country have been made possible.

A specific instance of the engineering work accomplished by Mr. Ferguson was the design and installation of one of the earliest and most comprehensive conduit and cable systems, complete with safety devices, fittings, and accessories; as well as their adaptation to the still earlier Edison three-wire tube system, together with essential improvements in the latter. His work on the electrical equipment of the Harrison St. station comprised many features which were then absolutely new, and the entire installation was recognized as the best of its kind at that time.

At the annual convention of the National Electric Light Association, in 1896, Mr. Ferguson presented a paper on the "Commercial Value of Acetylene Gas as an Illuminant," giving the results of his experiments in 1895 with Messrs. Wilson and Knapp at Spray, N. C., in the production of calcium carbide and acetylene gas. This was probably the most complete investigation that had ever been made of this subject. In 1897, he read a paper on "General Distribution from Central Stations by Direct Current," and in 1902 a valuable paper on "Rates." In 1897 he presented a paper at the annual convention of the Association of Edison Illuminating Companies on "The Economy in Distribution of Electrical Energy." This was considered very important in outlining the engineering policy to be followed by central station companies. At the convention of the same association, in 1898, he read a paper on "The Methods of Charging for Electrical Energy by the Chicago Edison Co." At a meeting of the Northwestern Electrical Association, in 1898, he read a paper on "Storage Batteries for Small Stations." His paper in 1902 before the American Institute of Electrical Engineers on "Distribution of Energy in Large Cities" was an important and timely contribution to this subject.

At the International Electrical Congress held in St. Louis during the summer of 1904, he contributed a paper containing a complete treatment of the subject of "Underground Electrical Construction," which attracted attention both in Europe and in America. In addition to the above papers, Mr. Ferguson has taken a conspicuous part in the presentation of a large number of important reports to the organizations mentioned. Among these may be noted a report made in 1897 to the National Electric Light Association on "Standard Candle-Power of Incandescent Lamps." This was prepared in conjunction with Dr. Louis Bell and Mr. James I. Ayer. It included the preparation of a suitable specification for standard incandescent lamps and the determination of a proper method for the commercial application of such a standard. As chairman of the storage battery committee of the Association of Edison Illuminating Companies since 1903, Mr. Ferguson has presented a number of valuable reports during the period of the greatest development of the storage battery in this country. He has also prepared a considerable number of able articles and reviews which have been published in the technical press.

Mr. Ferguson has the distinction of being the only man who has been honored by the presidency of the three great electrical associations in America. He is now President of the American Institute of Electrical Engineers. In 1901, he was elected President of the Association of Edison Illuminating Companies, and in 1902 the association showed its appreciation of his services by re-electing him to the same office. In 1902, also, he was elected President of the National Electric Light Association. Following his election to the presidency of these associations Mr. Ferguson was made a member of the executive committees of the National Electric Light Association and the Association of Edison Illuminating Companies, and has continued to [illegible] capacity up to the present time.

Mr. Ferguson was married at [illegible] Mass., to Miss Martha Sargent Jenk[illegible] 21, 1892, and has a family of two [illegible] daughter. He belongs to a number [illegible] clubs and to the Engineers' Club of [illegible] He has also taken a deep interest in [illegible] problems at Chicago.

Mr. Ferguson has made three trip[illegible] for the purpose of studying engineer[illegible] ments. Each was made just prior to [illegible] ration of some new and important [illegible] of the electrical industry in this [illegible] which he was thus prepared to appl[illegible] and most advanced knowledge obtain[illegible] abroad. It was on the strength of his [illegible] vestigation of European practice and [illegible] as set forth in his subseqeunt reports [illegible] mendations to the Chicago Edison Co[illegible] differential rates now so largely emp[illegible] into general use in the United States. It is not too much to say that Mr. Ferguson [illegible] the earliest exponents and advocate[illegible] country of what is now generally admitted to be the most equitable method of charging for electric light and power service.

Mr. Ferguson is a man of action, strong character and pleasing but aggressive personality. In the play of these qualities he has the deliberation which avoids mistakes and the tact which makes friends.

*President of the Chicago Telephone Co.

## George A. Mountain: President of the Canadian Society of Civil Engineers.

At its annual meeting at Toronto, on Jan. 28-30, 1909, the Canadian Society of Civil Engineers chose as its new president the Chief Engineer of the Dominion Board of Railway Commissioners, Mr. George A. Mountain, who before this had four times served the society as Councillor (1893, 1899, 1900, 1901) and twice as Vice-President (1903, 1905).

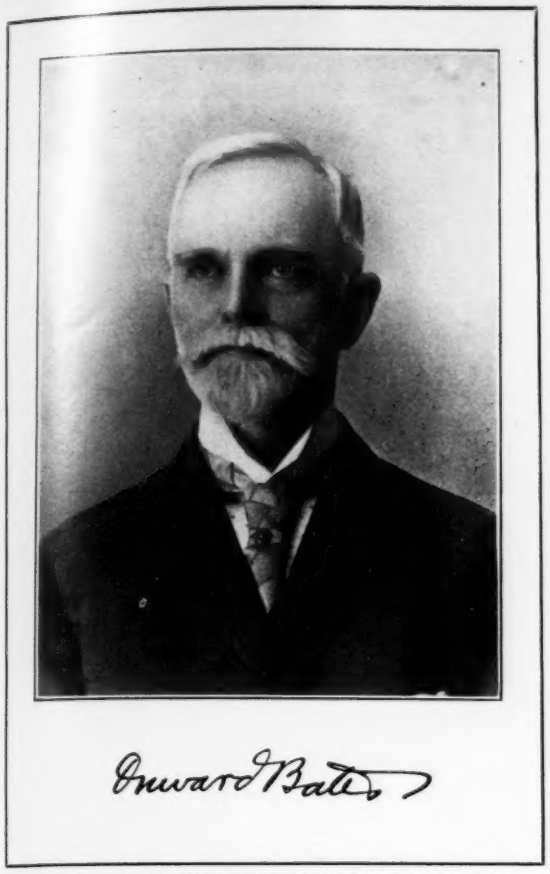
George A. Mountain was born in Quebec in 1860, and received his early education in civil engineering there. He served an apprenticeship with the City Engineer of Quebec, and later with Messrs. Kinipple and Morris, at London and Greenock. Since then his entire professional life has been spent in Canada, and practically all of it in railway service.

From 1878 to 1881 he was employed on railway survey and other work: in 1878 as transitman on the first surveys of the Quebec & Lake St. John Ry., in 1879 as instrumentman on the surveys of the Princess Louise Embankment at Quebec and of the Graving Dock at Levis, and in 1880 as first assistant on Division E of the Island Railway of Newfoundland.

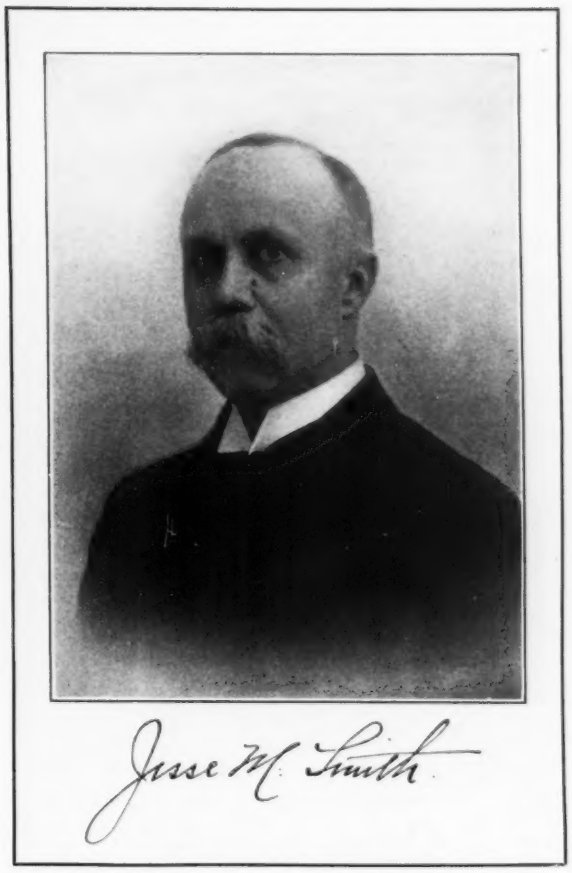
In March, 1881, Mr. Mountain entered the employ of the Canada Atlantic Railway, to remain with it for over 23 years. For five years he was Assistant Engineer under Mr. Walter Shanley, and on the resignation of the latter in 1886 he was made Chief Engineer, at the time when the steel bridge across the St. Lawrence River at Coteau was built. He retained this position until 1904. During his connection with the Canada Atlantic, Mr. Mountain in 1890 commenced the surveys for the Ottawa, Arnprior & Parry Sound Ry., from Ottawa to Georgian Bay. This road was completed in 1897, and was afterwards amalgamated with the Canada Atlantic Ry. system. In 1892 he was also Chief Engineer of the St. Lawrence & Adirondack Ry., running from Valleyfield, Que., to Malone, N. Y.

Mr. Mountain resigned his position as Chief Engineer of the Canada Atlantic in 1904 to become Chief Engineer to the Board of Railway Commissioners of Canada, which position he now holds.

Of Mr. Mountain's affiliations with technical societies we may mention—besides the one of which he has been elected president—the Dominion Land Surveyors, the American Railway Engineering and Maintenance of Way Association, the American Railway Bridge and Building Association, and the Royal Astronomical Society.



PRESIDENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.



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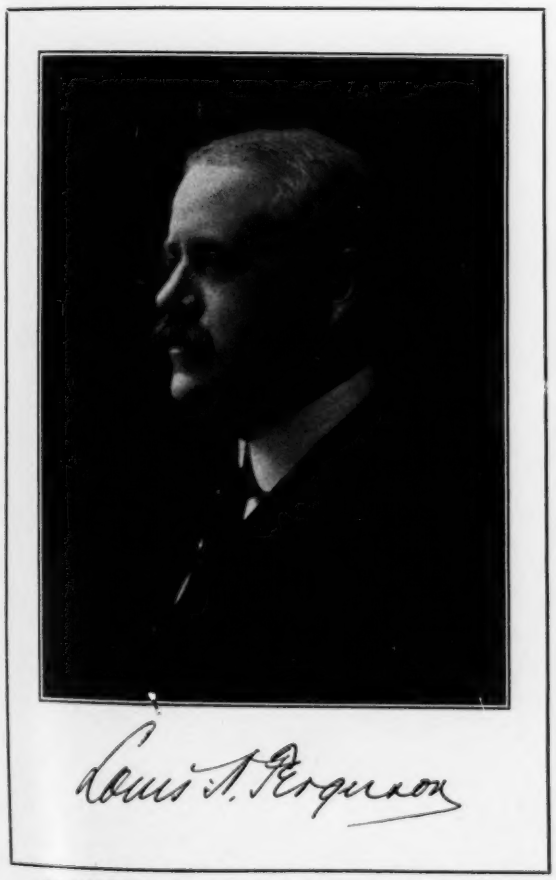

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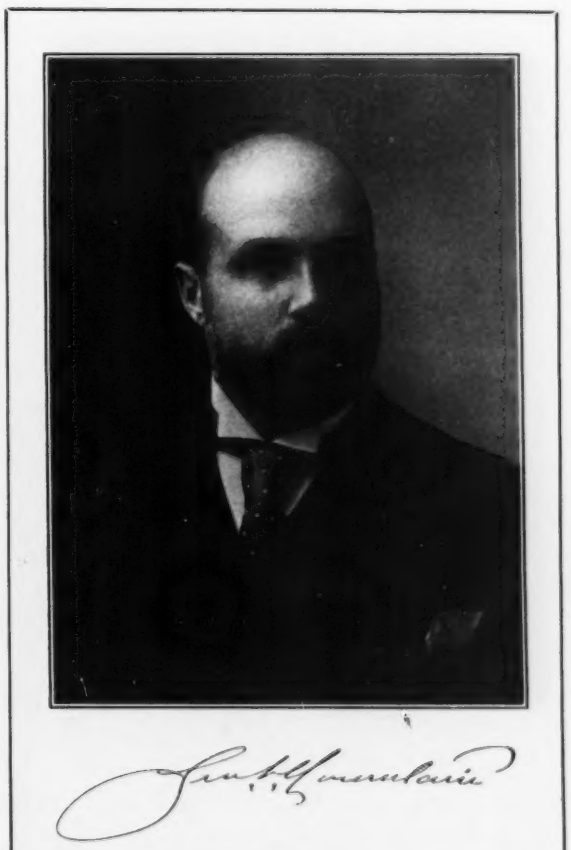

PRESIDENT OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

THE PRESIDENTS OF FOUR NATIONAL ENGINEERING SOCIETIES.

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The Cortlandt Street tunnel under the Hudson River at New York City, whose headings met recently, as recorded in our columns last week, has the proud distinction that throughout its 5,900 ft. of compressed-air work not a single man was killed or seriously injured through the pressure effects. It is very much the usual, the expected, event in pneumatic work conducted under pressures exceeding 25 lbs. that occasional severe cases of bends occur with generally a few fatal cases among them. When 30 lbs. is reached it is almost a foregone conclusion that there will be some proportion of serious attack. So far as we recall, no previous subaqueous tunnel using these pressures has been completed without a record of either deaths or very serious cases of compressed-air disease. The Cortlandt Street tunnel, with pressures of 25 to 34 lbs. per sq. in., is the first to come through with a clean slate—an enviable performance!

There may be some small element of good chance in this achievement, but unquestionably the main credit belongs to the skill and watchfulness of the medical staff. Thorough examination of the men's physical condition and well-systematized preventive measures and treatment have proven their value. It is to be hoped that in so far as the methods adopted here can be recorded, as to their successful features, this recording will not be omitted, to the effect that future pneumatic work may benefit thereby.

Whoever has occasion to attend technical meetings or conventions has had impressed upon him the immense amount of time and energy wasted in the reading of papers which are not prepared or intended for oral discussion. Time and again have we seen the whole audience, frankly uneasy or just as frankly asleep while the oblivious author or conscientious secretary toiled through page after page of complicated discussion which in no wise could be comprehended by a listener. While this is the more noticeable in those societies where the paper is not printed and distributed previous to its presentation, yet even the previous printing does not always save the meeting from a verbatim reading or, what is about as bad, a poor abstract. We therefore commend to all members of technical associations a recent decision of the American Society of Civil Engineers to exclude from oral discussion all papers which are of such nature as to require the close attention of the study. The order reads in part as follows:

> Papers, which, from their general nature, appear to be of a character suitable for oral discussion will be published as heretofore in "Proceedings," and set down for presentation to a future meeting of the society, and, on these, oral discussion, as well as written communications, will be solicited. All papers which do not come under this heading, that is to say, those which, from their mathematical or technical nature . . . are not adapted to oral discussion, will not be scheduled for presentation to any meeting. Such papers will be published in "Proceedings" in the same manner as those which are to be presented at meetings, but written discussions, only, will be requested for subsequent publication in "Proceedings" and with the paper in the volumes of "Transactions."

To a certain extent the society has always adhered to this rule, but from the first of the present year it is to publish its "Transactions" as quarterly volumes each equal in size to one of its previous semi-annual volumes, so that in future the amount of presented material will be much greater than can be placed before the semi-monthly meetings.

As the exclusion of the extremely complicated will tend to overemphasize the purely descriptive, the success of this move obviously depends upon the wisdom shown in the classification of the papers. However, with careful selection, the innovation cannot but be successful. If at the same time human nature could be so idealized as to confine discussion to remarks pertinent to the subject at hand, the average technical meeting would become more widely attended and more highly appreciated than it is at present.

Every engineer, no doubt, will be pleased to learn of the two Government projects for new large testing-machines, published in this issue of Engineering News. The widespread recognition that we are in urgent need of a testing-machine several times more powerful than any yet built is now met by the early prospect of obtaining such a machine, indeed a prospect for two machines of the kind, perhaps. Both machines are proposed by the Federal government, to be constructed at government cost and to be departmental property. This fully concedes the widely accepted view that a machine of the power asked for is beyond the ability of private interests to build or maintain, and that Congress should take steps to provide the machine. Only three weeks ago this view found prominent expression in a committee report to the American Society of Civil Engineers.

Those who are personally interested in the science of testing, or in the results of material tests, will find their attention more especially engaged, however, by the nature of the machines proposed. The Geological Survey machine and the Emery machine embody radically different principles, besides being of a different size. We doubt not that some engineers will hold that the differences are fundamental as regards the usefulness of the machines. For example, the Geological Survey machine is not able to weigh its load, and it is so big that we may doubt whether it can well be calibrated, or at least calibrated frequently; therefore it will be affected by the uncertainties which surround the results obtained on other hydraulic-press testing-machines. Depending on the individual viewpoint, there will of course be different opinions as to the bearing of this feature on the service value of the machine. The Geological Survey machine also is restricted to compression tests. Of course a universal machine is much preferable, and while for the moment interest is focused wholly on large-capacity compression testing, it is quite possible that the near future may develop reasons for desiring tests of correspondingly large tension members. The vertical arrangement of the one machine, as against the horizontal arrangement of the other, is another point for comparison. Still a further point, perhaps, is the matter of rigidity of frame, as affecting non-central resistance in struts at high loads.

As regards size, one machine being something over twice as powerful as the other, with 50% greater length-capacity at the same time, we may feel satisfied with either machine as an instrument for extending our knowledge of materials far beyond its present limit. One misconception must be guarded against, however. An unfortunate phrase in Mr. Humphrey's description conveys the erroneous impression that the Geological Survey machine is able to test columns as large as the chords of the Quebec and Blackwell's Island bridges. We believe that the chords which failed in the Quebec Bridge were carrying loads well above the machine's capacity of 10,000,000 lbs., and this was at a low unit-stress. For columns developing the moderate strength of 30,000 lbs. per sq. in., this machine would be limited to test sizes of 330 sq. ins. section. The Quebec Bridge, however, had chords of sections up to 800 sq. ins., while the largest Blackwell's Island chords exceed 1,100 sq. ins. The Geological Survey machine would therefore be limited to columns only one-third as large as the largest now in use.

We are informed that the Olsen machine is already in process of construction, and in fact is about half completed. Its main purpose, it seems, is to test large blocks of stone and built masonry. Under the circumstances, the larger machine, with its special adaptability to structural steel and concrete column tests, is still a thing to be greatly desired. The pinch comes in its enormous cost.

In the enlargement of passenger terminal stations to provide for an increase in traffic, the natural and almost universal method is to increase the width of the station so as to admit of a requisite number of additional tracks. In a very few cases, additional tracks are provided beneath the main station floor, being approached by inclines in the yard. These are intended usually for suburban traffic, which is thus separated from the main line traffic both as to the trains and the passengers. The lower floor is usually at the basement level, but in some cases where the main train floor is above the street level, it has been suggested that by closing one or two streets which pass under the approach viaduct the suburban tracks might be diverted beneath the viaduct and led into a special station at the street level, and beneath the main train floor. Another suggestion which has been made is to build a steel viaduct over the main line approach, and leading into an upper floor of the station.

A method which differs from all the above has been adopted and carried into execution at a large terminal station in London. This, as described elsewhere, consists in making the length of the station equal to that of two ordinary trains (the platforms being from 1,200 ft. to 1,400 ft. long), and arranging the tracks so that while a train is standing at the outer portion of a platform, another train can pass to or from the inner portion of the same platform. The station was widened at the same time, but the limits within which widening was possible were such that this alone could not provide for sufficient parallel tracks to give any great increase in train capacity. The lengthening of the station, however, together with the widening, increased the capacity threefold. In other words, the station can now accommodate 18 trains instead of six. This method has been introduced also in one part of the extension of the Central station at Glasgow, Scotland. Owing to the shape of the site available in that case, the station tracks are of unequal length, the concourse or platform being diagonal to the tracks and longitudinal platforms. This station has been widened to give additional tracks, but further accommodation is provided also by extending one of the main platforms to a total length of about 1,000 ft. and making its tracks long enough for two trains. The inner end of each track has switch connections with a parallel track.

The double-length arrangement has the disadvantage of increasing the distance between the trains and the station facilities (ticket offices, waiting rooms, etc.). On the other hand, it is quite possible that additional lateral exits will provide equally good means of access from the

trains to street cars, etc. In view of the continual growth of railway traffic and the congestion of main-line and suburban trains at large city terminals, and in view of the consequent necessity of providing additional facilities, it is of interest to consider the method in which the engineers solved the problem of increasing the traffic facilities of the London terminal, under the limitations of that particular case.

Cold shivers would have run down the backs of Jake Sharp and his aldermanic confederates in the Broadway street railway scandals of a quarter century ago had they awakened some morning to find that the board of aldermen had been shorn of all powers over franchise grants, and that those powers had been vested in a small body made up from the highest officials of the city. Their horror would have alternated with disgust on learning that this small franchise-granting body was in the habit of referring all franchise applications to its engineering department for investigation and report, and that each resulting report included a searching review of the facts bearing upon the application and embodied a formal franchise-contract, ready for execution, setting forth all the terms of the grant, putting a short limit on the life of the franchise and providing for compensation to the city. All these things have come about in the past few years, together with others no more pleasant to those who would exploit the city. Just what the present method of franchise-granting is may be learned from a brief contributed article elsewhere in this issue.

So far as we are aware, New York is the first city in the world to create a Division of Franchises, in which is centered the responsibility of investigating applications for franchises to use the public streets and of recommending the conditions of each grant. Heretofore public-service franchise grants almost everywhere have been subject to the chances of political or personal favoritism or prejudice. Where prejudice existed there has generally been a fair chance of changing it to favoritism by a proper (or rather an improper) use of money. In those instances where there has been a desire to safeguard public interests it has usually been true that the city authorities have been inexperienced in and quite ignorant of franchise matters and thus have been very poorly equipped to deal with franchise applicants who knew just what they wanted and just how to express it in terms meaning everything to themselves and little but confusion and helplessness to the city with which they were dealing. Under the present New York plan franchise-framing is entrusted to a well-organized branch of the city government. This Division of Franchises, as it is now officially known, has been in existence long enough to become thoroughly versed in all recent franchise matters in the city and if it lacks knowledge of earlier franchise events of moment, in New York or elsewhere, it is quite competent to post itself on them. The ultimate responsibility for the terms of franchise grants rests with the Board of Estimate and Apportionment, composed of the Mayor, Controller and other high officials of the city. The small size of this body and the high positions which its members hold center responsibility upon it to a degree far above what is found in that anomalous agglomeration, the usual American city council, which is about as irresponsible and as easily led astray as a flock of sheep.

Perhaps the most remarkable feature of this novel method of dealing with franchise grants is placing the Division of Franchises in charge of an engineer and having its head report to the Chief Engineer of the Board of Estimate and Apportionment. Precedent would have put a lawyer rather than an engineer at the head of the Division of Franchises and would have had the division report through the Corporation Counsel. The last-named officer is a member of the Board of Estimate and Apportionment and has never objected, so far as we know, to having the Division of Franchises manned and directed by engineers. All this, we think, is a notable and promising sign of the times, as well as a tribute to the engineering profession, and a highly deserved compliment to Mr. Nelson P. Lewis, M. Am. Soc. C. E., Chief Engineer of the Board of Estimate and Apportionment of New York City, and to Mr. Harry P. Nichols, Engineer-in-Charge of the Division of Franchises.

Strong measures for the state control of water pollution and of water and sewage purification are proposed in Minnesota and Indiana. If these measures are enacted by the respective legislatures, these two states will bring themselves into line with Massachusetts, New York, Pennsylvania, Ohio and Kansas. In brief, the proposed Minnesota and Indiana legislation provides that the respective state boards of health shall pass upon all plans for new or extensions to old sewerage and water-works systems, including purification works; shall have authority, on complaint, to require water and sewage-purification plants to be built; and shall also have power to see that existing water and sewage-purification works are properly operated.

With the exception of Ohio, none of the states which have preceded Indiana and Minnesota in advanced legislation of this class has given its state board of health administrative control over the operation of existing water and sewage-purification plants. The necessity for state control of the operation of such plants must be evident to any one who is familiar with the ignorance and carelessness with which many of the water and sewage-purification plants of the country are now being operated. If a state is justified in compelling a municipality to build a water or a sewage-purification plant in the interests of public health or to prevent serious offense, does it not logically follow that the state should also see that the plans which its representatives approve should be carefully followed in construction, and that the plants, once built, should be so operated as to give the protection which they were designed to provide? Early legislation of this class merely provided for state approval of water and sewage-purification plans and there let the matter drop. The works proposed might or might not be built, and if built they might or might not follow the plans which had been approved by the state authorities. There was, however, at least a fair chance that the plans approved would be followed during construction, but whether or not the works would be properly operated after once constructed was very uncertain. In the early legislation requiring such plans to be approved by state authorities, it may also be noted, the matter of entering upon the construction of works was left optional with the municipality; that is to say, boards of health or other state authorities usually had no jurisdiction until the municipality, of its own initiative, decided to provide water-works or sewers or means of water or sewage purification. The more progressive of the recent legislation wisely empowers the state boards of health to say to a municipality, after proper complaint and investigation, "You must purify your water-supply or treat your sewage, and that without delay, and the plans for the work must meet with our approval." A still more advanced stand, as already noted, is to require that the works when built shall be properly operated.

Both Indiana and Minnesota stand in great need of the legislation proposed. We shall speak here only of the needs of Minnesota, not because they differ materially from those of other states, but because particular attention has recently been called to the necessity of state supervision of public water-supplies by the outbreak of typhoid fever in Mankato, described elsewhere in this issue. That outbreak, according to the author of the article, was due to possible dangers menacing the water-supply, of which local authorities had no conception whatever. Possibly these dangers would have been overlooked under state supervision, as they were of a somewhat peculiar character; but the broader knowledge of water-supply and sewerage and of water and sewage purification gained by responsible state authorities who are passing upon related problems as they arise throughout a large state, makes it far more likely that special dangers to the public health [illegible] be recognized by the state than by local a[illegible]rities.

While the conservation of the pu[illegible] health of any given community may alone [illegible] sufficient warrant for state supervision in s[illegible]tary matters, there were in the Mankato [illegible]hoid outbreck, and there are generally in [illegible]hoid epidemics, dangers which extend far [illegible]yond the boundary of the municipality prim[illegible]y affected. Reference to the interesting map [illegible]ch accompanies Pros. Bass's article on the [illegible]kato outbreak, together with the explanator[illegible]ext, shows how widespread may be the effects [illegible] typhoid outbreak even in a relatively small [illegible]mmunity. The Mankato outbreak, it appears, [illegible]s responsible for at least 72 cases and 5 d[illegible]s outside that city. Who can say how many [illegible]ases and deaths have occurred in connection with other and larger typhoid epidemics, and [illegible]rticularly have been incident to the shameful [illegible]nditions of endemic typhoid which until recently prevailed in such great centers of population as Pittsburg and Philadelphia, and earlier still in Chicago?

We sincerely hope that the proposed sanitary legislation in both Indiana and Minnesota will be enacted, and that when enacted the provisions of the proposed laws will be vigorously enforced.

## Is the Civil Engineer Corps of the Navy to be Destroyed?

After many years of excellent service, the civil engineering corps of the Navy is to be wiped out. The long contention of the Bureau of Construction and Repair with the Bureau of Yards and Docks has ended in the final subjugation of the latter. In the future, Annapolis men trained in ship design will plan and execute all navy-yard construction work, from paving a street to repairing or building a drydock. It is to become established that "Only a Colonel from Chatham can manage the railways of state," raise a "Yankee" or repair a decrepit drydock.

This is only part of a more extensive revolution in the government's navy yards, but it is the feature which concerns the non-naval engineering circles most directly. The navy-yard reorganization is accomplished by a Department order issued by Secretary Newberry with the approval of the President. In form it is only preliminary, but in substance it is final. While it does not establish a definite new organization it effectually uproots that which now exists. Its text may interest our readers:

**General Order No. 9.**

NAVY DEPARTMENT,
Washington, D. C., January 25, 1909.

For the purpose of consolidating the manufacturing force at navy yards, on February 1 the commandants of all navy yards and stations (except the Washington Navy Yard, the Torpedo Station, the Proving Ground and Naval Magazines) shall place all work not involved in the handling of stores, the manufacture of clothing, or the preparation and handling of provisions, in the hands of the naval constructor, who, as the principal technical assistant to the commandant, shall thereafter, under his direction, be responsible for the efficiency of the manufacturing force of the navy yard.

The commandant shall place all public works and the equipment thereof under the control of the above-named technical assistant, under such regulations as the commandant may for the time being prescribe, and therewith such drafting and clerical force as he may deem necessary. The status and duties of the captain of the yard, general storekeeper, medical officer, pay officer, and officer in charge of provisions and clothing are in no wise affected by this order. The heads of the now existing departments of ordnance, equipment, and steam engineering may remain on duty under the title and discharge the functions of inspector of ordnance, inspector of equipment, inspector of machinery, retaining, subject to the commandant's approval, such clerical force and such assistants as may be necessary for the purpose of inspecting the work done for them by the consolidated manufacturing department.

The inspection of all ordinary supplies shall, as a rule, be made by the officers directly attached to the manufacturing department, but any special articles or appliances shall be inspected by such officers as the commandant may direct.

The civil engineer will be attached to the commandant's office, as consulting engineer and inspector of public works, for the purpose of inspecting such work as may be done on docks, dry docks, railways, etc., and

generally recognized under the term of "public works." To this end he shall be granted such assistants and such clerical and other force as the commandant may deem necessary.

In a general way, the effect of this order will be to make the commandant, while, as heretofore, paramount, resemble, as to his connection with yard work, the president of a large industrial plant; the principal technical assistant becoming, under the commandant, the general manager.

All officers now on duty at navy yards and naval stations shall at once report, in writing, to the commandant for such duty as he may prescribe.

Until definite regulations governing the methods of carrying on work and interrelation of officers have been promulgated by the Department, the execution of this order devolves upon the commandant, who is empowered to arrange all the details provisionally.

On the 13th day of February, 1909, the commandants of navy yards and naval stations shall forward to the Secretary of the Navy a report of what has been done in compliance with this order, specifically stating the names and occupations of every person, whether officer or employee, left under the direct orders of the inspectors of ordnance, equipment, machinery and public works, respectively.

The consolidated manufacturing department shall, as soon as practicable, institute one pay roll for all navy yard workmen under its supervision or that of the inspectors. There will be another roll for the civil service employees, including foremen.

TRUMAN H. NEWBERRY,
Secretary.

Approved, and such changes in the regulations as are made necessary by this order are authorized.

The White House, January 25, 1909.

THEODORE ROOSEVELT.

The general reorganization of the Navy now pending we do not need to discuss. Be it noted only that a Board has been appointed to study the question and to make recommendations. The Board has but just begun its work, and the above order is therefore not the result of its deliberations. But perhaps the Board is to deal only with Washington bureau conditions.

That part of the order which concerns us takes away from the members of the Civil Engineering Corps all their functions of planning, designing and executing the yard works, and assigns these functions to the Naval Constructor. What is left for the Civil Engineer of the yard to do is not clear. The text of the order makes him consulting engineer to the Commandant and *inspector of public works*, "for the purpose of inspecting * * public works." In detail he may be assigned various duties by the Commandant, no doubt, until more specific orders come from the Department after the various yards have worked out the new situation in their own ways.

It is difficult to avoid the conclusion that the Civil Engineer is in effect degraded to inspector, a position which in civil life is usually an entirely subordinate position filled by young men, recent graduates, and the like. It is likely, too, that in the present application of the order at the several yards, the civil engineer may become virtually a subordinate of the Naval Constructor's organization. In any case, the order marks the final submergence of the corps. For, while various line officers are in a similar position, they have the certain prospect of early and steady advancement. The civilian members of the civil engineer corps, on the contrary, being by law restricted to low rank, and now by this order limited to inferior duties, are in no better strategic position than Warrant Officers.

If in the past it has been exceedingly difficult to enlist engineers from civil life to enter the corps of Civil Engineers of the Navy, the new state of affairs will obviously render it wholly impossible. More than this, however: it seems most probable that the present members of the corps cannot consent to remain in service under the new order of things, and will soon disappear from the Navy by resignation.

This means, of course, that in the future the corps will be formed of Annapolis men exclusively. This is in effect a reconstituting of the Civil Engineer corps parallel to that of the engine room staff of naval vessels, begun half a dozen years ago. Both changes create a staff corps, composed of Annapolis men, but so segregated in training and duties from the Line that the mutual jealousies and animosities of the recent past will be accentuated rather than softened. Surely the Civil Engineer officer can never attain to the position of Naval Constructor, and may therefore not advance to the influential place of General Manager of a Navy Yard. Nor can he ever return to Line duty, as little as the officer on duty in the engine-room can aspire to future command of a ship. For, judging from past history, of the entire "staff" organization only the Medical Corps has the possibility of reaching command of a naval vessel.

We cannot escape the conclusion that General Order No. 9, if it lives, will not merely wipe out the Civil Engineer Corps as a body of men drawn from civil life, but will in fact make it impossible to maintain *any* capable organization for conducting the civil engineering construction of the yards. Naval service of to-day is a complex of specialties. A battleship commander or a ship designer cannot be capable of planning and directing civil engineering construction; or, if he is experienced and capable in this field, he is for that reason incapable of navigating a fighting vessel or of designing a ship. We must assume that the rank of Naval Constructor will always be reserved for officers educated specially in shipbuilding, since the yards exist primarily for repairing, building and equipping ships. An officer who enters the civil engineer corps will therefore never become fitted for the position of General Manager of the Yard, this being reserved for Naval Constructors by the order. His only hope for attaining high place will lie in his ultimate return to the fighting Line. But if he devotes himself to his civil engineering functions he would soon become hopelessly unsuited for Line command. Necessarily he will feel disposed to take his civil engineering functions as lightly as possible, and escape from the distasteful, futureless position at the earliest moment.

The eternal contest between Line and Staff is, of course, immediately concerned in the matter. If the Line tradition is really fundamental—that only Line officers can attain to high place and command, then there is something wrong with the present system. The best material in the Naval Academy is taken out to recruit the corps of Naval Constructors. Other specially good material is for some years past being applied to the engine-room staff. And in the future the technically able element is to be exiled into the Civil Engineer branch. What is left, having no special adaptability, is poured into the general Line hopper, to be refined into Rear-Admirals and Admirals and to be solely privileged to the highest places.

Such a system may be workable so long as the segregated branches have duties and responsibilities of a character adapted to satisfy the upward-looking spirit of man. The Engineer Corps of the Army instances this. But in the opposite event the result can only be dissatisfaction and inefficiency.

The corps of Naval Constructors has suffered under the latter condition. Recruited from the best portion of the Academy's output it has nevertheless been sadly hampered in the matter of advancement. The change of base effected by General Order No. 9 at once places the corps in a very advantageous relation to the service. But however just this may be, it is deplorable in so far as it entrains the destruction of the present machinery for carrying on "public works" construction and prevents the upbuilding of a substitute civil engineering corps. Its effect on the ordnance and mechanical branches may perhaps be equally fatal; but our first attention is claimed by the unappreciative killing off of a conscientious, able body of civilian engineers.

**THE RAILWAY TERMINAL AT VERA CRUZ, MEX.,** has just been placed under construction. There has been at this point for some time a terminal of the Vera Cruz & Pacific Ry., but within the past two years the Tehuantepec National Ry. of Mexico has been connected to the former line so that the terminal facilities have to be increased. The new terminal work at Vera Cruz, estimated to cost $8,000,000, is to contain a great amount of reinforced-concrete construction; all of the buildings are to be of that material and most of the bridge work also. It is this portion of the project which is now under way.

# LETTERS TO THE EDITOR.

## Defects of a Design Competition.

Sir: Inspection of the offered competition noted in your editorial and advertising columns of Jan. 28 gives much food for thought.

In the first place the compensation is entirely inadequate. Second, there is no definite statement that any plans will be adopted. Third, there is no definite statement that a successful competitor is to be retained on any terms to carry out the designs submitted by him. Lastly, there is no protection afforded an unsuccessful bidder whose scheme nevertheless contains points of value.

As the matter is presented the prospects are that schemes for the solution of this problem will be received only from builders of conveying apparatus whose work would be done without charge anyhow, or else from inexperienced amateurs whose ideas would be of no great value, the terms being entirely inadequate and otherwise uninteresting to engineers whose work is worth while.

Very truly yours,
G. K. Hooper.

11 Broadway, New York City, Jan. 29, 1909.

[We quite agree with our correspondent that the competition referred to was defective in a number of vital points. If similar competitions were to come into wider use, more rigid principles would have to be established. The need for a very positive code of rules or principles to govern competitions has been recognized long ago in architectural practice. Even in Europe, however, where architectural competitions vegetate alarmingly, so that they are almost an epidemic disease, there is constant complaint of improper specifying of conditions, and often there is open charge that those who enter a competition find it necessary to shape their designs to suit the jury of award rather than to suit the physical and aesthetic conditions prescribed. Still it is easy to fix certain first principles which are essential if the competition is to be really fair and open, and the one in question obviously did not give due recognition to all these principles. In an individual instance, of course, the fairness and good faith of the offering party may suffice to protect the competitors satisfactorily.—Ed.]

## The Surface Temperature of an Asphalt Pavement.

Sir: The accompanying table is a record of some observations of the temperature of an asphalt pavement in hot weather which were taken at Waterloo, Iowa, (latitude 42°-30′ N) during the past summer. The temperatures given may be considered as the ordinary maximum, although the weather records show that periods of a few days in duration of weather reaching a higher temperature are occasionally experienced.

The thermometer used for the readings was one which had been so often compared with the official government thermometer as to give confidence in the readings. It was placed upon the pavement under the direct rays of the sun and closely watched. The readings given are the maximum and minimum points during the period of observation.

In the column headed "Government Thermometer" are the readings given by the official thermometer of the U. S. Weather Bureau, which were taken just before and just after any given series of readings on the pavement. This thermometer was located only about 100 ft. away from the point at which the readings on the pavement were taken.

The street upon which the readings were taken (Mulberry, between 4th and 5th) was paved with "Genasco" asphalt in 1905 by the Barber Asphalt Co.

Attention is particularly called to the noticeable effect of a passing cloud on July 30; a drop of 8° in as many minutes and a recovery to the normal temperature in less than two minutes.

Yours truly,
Ralph B. Slippy, C. E.

102 So. Romaine St., Urbana, Ill., Feb. 5, 1909.

TEMPERATURE READINGS ON ASPHALT PAVEMENT.

| Date, 1908. | Time. | Temperature. | Government Thermometer. | Remarks. |
|---|---|---|---|---|
| July 30, | 2.15 P. M. | 90°F. | 90°F. | Northwest wind. |
| | 2.20 | 116° | .. | |
| | 2.28 | 108° | .. | Passing cloud. |
| | 2.30 | 116° | .. | |
| | 2.33 | 117° | .. | |
| | 2.34 | 113° | 90° | Light cloud. |
| July 31, | 4.10 P. M. | 85° | 85° | Clear, N. E. wind. |
| | 4.11 | 100° | .. | |
| | 4.12 | 107° | .. | |
| | 4.15 | 113° | 85 | Remained at 113. |
| Aug. 1, | 10.20 A. M. | 82° | 82° | Clear, east wind. |
| | 10.25 | 115° | .. | |
| | 10.30 | 110° | .. | |
| | 11.45 | 120° | 84° | |
| | 11.55 | 128° | .. | |
| | 12.00 | 120° | 84° | |

## Stock-Selling "Employers."

Sir: In your issue of Jan. 14 I notice an article published as a warning and word of caution to engineers against a certain class of promoter referred to therein. This article treated of a special enterprise and of a subscriber who was induced to take stocks in a fraudulent scheme, but fortunately succeeded in obtaining back his money put into this scheme of fraud and deception. This special case seems to coincide exactly with two cases which came directly under my observation. I, for instance, am one of the parties who have subscribed for shares under the same conditions as outlined in the article. Judging from this article, the promoters of the scheme referred to therein and of the one into which I have been induced to go are one and the same. I should be pleased therefore to communicate with the gentlemen who made this fraud of a promoter disgorge, as I think I will be enabled to trace down my man to his lair, as it were. I will consider his information quite confidential indeed and in best of faith. These frauds and fakes should be traced down and, thus, the more that get after them in the chase the better we will succeed. I shall be glad to have him write me in care of Engineering News.

X. Y. Z.

Jan. 24, 1909.

[Within a few days of the above we received from another party a stock-selling employment letter sent him in answer to an application for employment. The letter is suggestive, and may interest others, particularly because the undertaking on whose behalf the letter was written is one concerning whose good faith we had previously no reason to be suspicious. The "chief engineer" of this undertaking writes:

Dear Sir:

Yours of the 16th at hand. Replying to same will say that I am looking for an assistant chief engineer that can come in with the company on the ground floor, and become financially identified with us.

To a practical, clean cut man, who can invest $3,000 there is an excellent opening both as to position and investment.

Should this interest you, let me know at once, as place will be filled in a few days.

Yours truly, ——

The letter implies very directly that the special fitness of the applicant for the position is of minor interest, and that his $3,000 is the object at issue. The smallest modicum of caution, of course, will suggest to the recipient of such a letter that the "ground floor" is apt to give way and drop him into a bad hole.—Ed.]

## Recent Experience with Bank Protection Works at Pine Bluff, Ark.

Sir: Your article published under date of Jan. 28, 1909, p. 103, in which you quote an article on the above subject by Major M. L. Walker, gives a very clear explanation of the recent experiences, and of the present situation; but had you extended your sketch a sufficient amount to have included an outline of the entire city of Pine Bluff, it would have given much additional evidence in refutation of the sensational reports published in the newspapers at the time of the flood. These reports having brought inquiries from other sections of the country as to whether or not outside aid would be needed, under the impression that the greater part of the city was being destroyed. One or more of the business organizations sent out statements at the time in an effort to correct this wrong impression.

Although larger in proportion from the view-point of property values, you will note the small proportion in area that was caved off the river front, when you consider that the business part of the city extends five or more blocks back from this caving and the residence part ten or more blocks additional.

It is appropriate also at this time to sound a note of warning to the interests situated along the river bank and particularly just below the present point of attack. The erosion of Boyds Point is bound to continue with each recurrent flood and as the point recedes the attack on the Pine Bluff side will advance down stream.

Major Walker states that with the funds now available, he will be able to hold the situation until the next low water season. Now is the time to raise the funds necessary for the extension of the work down stream, so that they will be available for the commencement of the protection work just as soon as low water occurs; because this work must be kept well in advance of the recession of Boyds Point. And if these funds are not provided in sufficient time to permit of the work being placed, it will not be the fault of the Corps of Engineers, U. S. A., if the following floods cause additional caving as well as the probable loss of a part of the work that is being placed at present.

The local Representatives in Congress are making a strong plea for a special appropriation, and it is hoped that they will succeed; but this brings up the question as to whether or not the general Government should bear the entire burden of such protection work. In this case the local interests have expended considerable sums in emergency protection work, and no doubt are prepared to assist in the more permanent protection. But the point to be emphasized is the fact that if a similar amount of money had been expended in repair work during the last low water season, the recent property loss would not have occurred. It is not a very hard matter to figure for such cases, where valuable property is located in the vicinity of caving banks, that it is economy to construct and maintain protection works, but it is a harder matter to ascertain what proportion of the cost should be borne by the local interests and what by the Government.

Yours very truly,

Chas. H. Miller,

Engr. River Protection, Mo. Pac. Ry. Co.

Little Rock, Ark., Feb. 1, 1909.

## Possible Confusion of the Hetch-Hetchy and Yosemite Valleys in the San Francisco Water-Supply Discussions.

Sir: In your editorial note of Jan. 7, 1909, relative to San Francisco's water-supply, the words "Yosemite Park" and "Yosemite National Park" are used and, I fear, are confused with "Yosemite Valley" in the minds of many of your readers. The impression left, seemingly, is that the "Yosemite Valley" is to be converted into a storage reservoir. This impression is augmented by Mr. R. U. Johnson when he says (Eng. News, Jan. 21, p. 75) "you are in error also in saying that I have not been in the Yosemite Valley" (which you did not say). As a native of California, born and brought up upon the banks of the Mokelumne River, I have been over the roads and have camped in this wonderful mountain region, both upon the Tuolumne and the Merced, and I wish to say that if Mr. Johnson had ever been up along the Tuolumne River (where this reservoir is to be located), and had actually traveled from there to the Merced River he would not use the words "Yosemite Valley" (which is located on the Merced River) almost interchangeably, nor would he speak of the Tuolumne scenery as in any way comparable to that found on the Merced. Thousands know and enjoy the wonderful scenery in the Yosemite Valley (upon the Merced River) where one knows anything more than vaguely of the not unusual scenery along the canyons of the Tuolumne River.

Very truly yours,

J. Calvin Locke.

784 Marcy Ave., Brooklyn, N. Y., Feb. 2, 1909.

[We think those who have followed at all carefully the discussion of this matter, in our issues of Jan. 7 and 21 and Feb. 4, will not confuse the Hetch-Hetchy and Yosemite valleys, although the earlier discussions may have given rise to such confusion.—Ed.]

## Still More About Forests, Snow and Stream Flow.

Sir: The arguments of the anti-forest correspondents printed in your columns during the past few months first amused me, but now their persistence is annoying and you seem to be the only one championing the cause of forest preservation for the protection of water-supplies.

To one who has spent considerable time among the Rockies of southwestern Colorado, as I have, the discussion is as ridiculous as that of forest preservation above timber line.

Why should not the snow in large drifts in sheltered gulches and on the shady slopes of the mountains remain the year round? Why should it melt when the temperature is below 32° for 18 hours each day during the summer months? And if it don't melt, as they say it does not, of what value is it to the supply of the streams?

When warm winds blow or warm rains fall the unforested snow banks give a practical illustration of their potentialities as storage reservoirs. That they certainly contain volumes of water, is evident from the many destructive floods that occur annually in the mountain country every spring before there is any use for the water for irrigation. All of these have their origin on the untimbered areas above timber line and I would like to see anybody who could deny this if he ever watched the flow of the La Plata, San Juan, San Miguel, or the Grand rivers.

I came as near famishing for a drink of water above timber line in the Needle Mountains as I ever did in the Colorado Desert and there were great banks of snow but not a drop of water in sight. The streams heading above timber line receive a supply from the melting drifts for only a portion of the day and an hour after sun down they cease entirely. The steady flow which counts comes from the forested areas.

Let the skeptics try their hands in working in a tunnel in the forested area and they will soon find out where the water comes from. Let any one of them get out, as I have, and hunt for a drink of water, as I have, and he will do as I did, head for the tall timber and only need to dig in the first gully to get all he wants.

Clear the forests off the mountain slopes and see what will happen. Every mountain side will be swept clean to bed rock and the rock polished till it shines like a billiard ball. The gulches will be piled full of loose rocks; also with snow and ice that will pour forth torrents, when warm wind or rain strikes it, that will sweep the valleys below.

I don't care what all the learned authorities and scientific savants have to say. Seeing is believing. I have seen with my own eyes the effects of forest preserving snow and ice that had fallen in the winter and in late July in the Lake of the Woods country.

Very truly,

J. H. Eby.

Lancaster, Pa., Jan. 30, 1909.

## An Important Possibility in Working Drawings.

Sir: An editorial under the above caption appeared on page 106 of your issue of Jan. 28, 1909. A most casual reading of this editorial must give the impression how conservative a profession engineering is and how slow improvements and reforms in engineering methods are made.

The editorial speaks of an innovation just come to notice, that of small-size working drawings of such size as to be conveniently carried about in the pocket. Solomon says "There is nothing new under the sun." As I write I have before me three volumes of "small-size working drawings," one volume containing drawings of bridges and culverts between Phoenixville and Port Clinton, Pa., along the line of the Pennsylvania Schuylkill Valley R. R., built during the years 1883-85; the second volume, drawings of the same railroad, between Stony Creek and Mill Creek, south and north of Pottsville, Pa., built during the year 1885, and the third, masonry structures on the Clinch Valley Division, Norfolk and Western R. R., built during the years 1887, '88 and '89. The drawings are made on sheets 8 × 11 ins. inside of border lines (one case 8 × 10 ins.) and generally drawn to scales of 10 to 20 ft. per inch. The drawings, although not reproduced (reduced) by photographic process, are exact counterparts of the larger working drawings, except the scale. They contain every requisite for laying out the structure on the ground, building the same and calculating the cubic contents.

It will be noted that the earlier of these drawings were made 26 years ago, during which long time a very excellent idea lay dormant, to be resurrected by some enterprising engineer. It certainly does not speak well for a profession which is always prating about making a dollar do something that it costs some one else two dollars, etc., etc., etc., not to take advantage of a method which has so many points to recommend it.

Right at this time, why would it not be a good plan to adopt a fixed size for these photographic reductions. I would advocate the same size as an ordinary letter sheet, which unfortunately ranges from 8 to 10½ ins. to 8½ × 11 ins. With uniform size, interchange of drawings might be feasible, and for convenience in filing an absolute size would possess many advantages.

It is my wish (as yours) that the printing of these small size drawings may become universal. But will it be realized?

Yours truly,

Emile Low, M. Am. Soc. C. E.

606 Ashland Ave., Buffalo, N. Y.

[The drawings referred to, of which Mr. Low sends us specimen blueprints, illustrate a point made in our editorial, namely, that it is not practicable to make original drawings to such a small scale and obtain satisfactorily clear, easily legible results. It can be done, but only by the exercise of specially high skill. The photographic reduction process yields better results and requires only moderate skill in the drafting-room. Mr. Low's blueprints show irregular-formed lettering, often very minute, but in all cases hard to read, besides corresponding faults in the execution of the drawing itself. With the photographic reduction method the same matter could have been portrayed to even smaller scale, or more matter put on the sheet, with far greater legibility, in fact, with all desired legibility.

The above letter speaks of small drawings which are "exact counterparts of the larger working drawings." But there should be no "larger working drawings" according to our proposal, since the small reductions are themselves to be the working drawings. With proper execution, as we said, they can be made to meet every purpose served by large drawings.

The size of 8 × 10 was suggested, of course, because this is a regular photo-plate size. It

seems most suitable of the commercial sizes, for the purpose discussed. White prints from a negative, i. e., black lines on white ground, are a little more easily read than a blueprint, which in this case would show blue lines on white ground; but with good negatives and careful printing, such blueprints might be fully as effective as the white prints, and have the advantage of thinner paper.—Ed.]

## Blast Furnace Proportions.

Sir: I have compiled the accompanying comparative table of blast furnace dimensions which will be a valuable addition to the notes of engineers interested in iron and steel production. Inasmuch as the names given the different sections of a blast furnace vary with the locality in which it stands, a sketch has been added to define the names as used in the table.

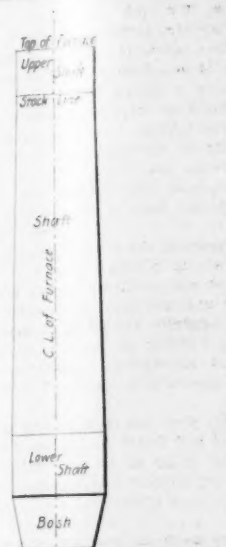



Diagram of Blast Furnace, Showing Names of Sections.

The nominal capacities have been computed by the empirical formula (capacity, in tons output per day, equals the product of over-all height in feet and the square of the diameter of the bosh in feet divided by 100) which is in common use both in the United States and abroad. The omission of the height of lower-shaft indicates the absence of that section in the furnace, and the location or number of tuyeres is omitted in some cases due to the missing of these data.

The "Central No. 5" (No. 21 in the table) has a cylindrical upper-shaft 8 ft. high, and "Joliet No. 3" (No. 17 in the table) has one 9 ft. ¾-in. high. "Union No. 3," of the Illinois Steel Co. (No. 4 in table) has a conical upper-shaft with dimensions as follows: Large diameter, 13 ft. 1 in.; diameter at furnace top, 12 ft. 1 in.; height, 7 ft. 2½ ins. The "Neville Island" furnace (No. 24) has an upper-shaft 8 ft. high, as have also the two "South Works" furnaces (Nos. 22 and 23).

For more economical operation some ironworks have enlarged the diameter of the hearth and even increased the height of the bosh or inserted a cylindrical lower-shaft, thus adding to the capacity of the furnace. Many such changes were effected during the industrial depression of last year.

Yours very truly,

O. V. de Gaigne.

84, 163 Randolph St., Chicago, Ill., Jan. 13, 1909.

COMPARATIVE TABLE OF BLAST FURNACE DIMENSIONS.

| | Name, Location and Owner. | Approx. nominal capacity in tons, per day. | Capacity in cu. ft. Hearth. | Bosh. | Shaft. | Total. | Over all height. | Diameter Hearth. | Bosh. | Top. | Height Lower shaft. | Bosh. | Hearth. | Stockline to top. | Cinder notch. | Tuyeres. | No. of tuyeres. | No. of furnace. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Newburgh No. 3; Cleveland, O.; Am. St. & Wire Co.. | 156 | 760* | 1,189 | 5,338 | 7,287 | 60' 8" | 10' 6" | 16' | 10' 6" | ..... | 38' 2" | 6' 4" | 4' | 7' | .. | 1 |
| 2. | Milwaukee Works Nos. 1 & 2; Milwaukee, Wis.; Federal Steel Co..... | 169 | 505* | 1,587 | 6,472 | 8,564 | 68' | 9' 6" | 16' | 12' 6" | 4' 2" | 35' 2" | 8' | | 3' 3" | 4' 9" | 7 | 2 |
| 3. | North Works Nos. 1 & 2; Chicago, Ill.; Federal Steel Co..... | 169 | 515* | 1,627 | 5,843 | 7,985 | 66' | 9' 6" | 16' | 11' 6" | ..... | 39' | 8' | 3' 8" | 4' 9" | 7 | 3 |
| 4. | Union No. 3; Chicago, Ill.; Federal Steel Co..... | 170 | 630* | 1,246 | 6,566 | 8,742 | 72' 5" | 10' | 15' 4" | 12' | 10' 10½" | 23' 7½" | 10' | 3' 9" | 6' | .. | 4 |
| 5. | Union No. 4; same as above..... | 172 | 610* | 1,342 | 7,093 | 9,045 | 73' | 10' | 15' 4" | 12' 1½" | 10' 6" | 34' 6" | 10' | 3' 9" | 5' 9" | .. | 5 |
| 6. | Emma No. 4; Cleveland, Ohio; Am. Steel & Wire Co. | 210 | 960* | 1,556 | 8,007 | 10,610 | 72' 7½" | 12' | 17' | 12' 7½" | ..... | 45' 6" | 10' 2" | 4' | 7' | .. | 6 |
| 7. | Franklin ..... | 253 | 980 | 2,200 | 8,500 | 11,380 | 74' 0¾" | 10' 9" | 18' | 13' 2" | ..... | 43' 4" | 10' | 4' 3" | ..... | 12 | 7 |
| 8. | Thomas; Milwaukee, Wis.; Thomas Furnace Co.... | 255 | 690 | 2,170 | 9,180 | 12,030 | 76' 2¾" | 10' 8" | 18' | 13' | ..... | 47' 5¾" | 10' | 4' | ..... | 16 | 8 |
| 9. | Shenango & Neshannock..... | 258 | 718 | 2,550 | 8,750 | 12,018 | 75' | 11' | 18' | 13' 6" | ..... | 42' 5¾" | 10' | 4' | ..... | 16 | 9 |
| 10. | Steelton; Steelton, Pa.; Penna. Steel Co..... | 272 | 910 | 2,220 | 9,370 | 12,500 | 84' | 11' 6" | 18' | 13' 8¾" | ..... | 48' 3" | 10' | 5' | ..... | 10 | 10 |
| 11. | Bellaire No. 2; Bellaire, Ohio; Carnegie Steel Co.... | 272 | 800 | 2,725 | 9,350 | 12,875 | 75' 2" | 12' 6" | 19' | 14' | ..... | 44' 8" | 10' | 3' 3" | ..... | 12 | 11 |
| 12. | Sharon No. 2; Sharon, Pa.; Carnegie Steel Co..... | 273 | 670 | 2,020 | 10,480 | 13,170 | 84' 6" | 11' | 18' | 13' 6" | ..... | 53' 5¾" | 10' | 3' 10½" | ..... | 12 | 12 |
| 13. | Bellaire No. 1; Bellaire, Ohio; Carnegie Steel Co.... | 275 | 800 | 2,130 | 10,160 | 13,090 | 76' | 12' 6" | 19' | 13' 6" | ..... | 48' 5¾" | 10' | 3' 8" | ..... | 12 | 13 |
| 14. | Iroquois; South Chicago, Ill.; Iroquois Iron Co..... | 291 | 728 | 2,408 | 11,675 | 14,811 | 85' | 11' 6" | 18' | 13' 9" | ..... | 57' 2" | 7' 10" | 4' | 6' 6" | 10† | 14 |
| 15. | Joliet No. 1; Joliet, Ill.; Federal Steel Co..... | 312 | 1,200* | 2,279 | 11,477 | 15,022 | 77' 11¾" | 13' | 20' | 14' 8" | 8' | 35' 8¾" | 10' | 4' 6" | 7' 3" | .. | 15 |
| 16. | Joliet No. 2; same as above..... | 312 | 1,200* | 2,713 | 10,849 | 14,828 | 77' 11¾" | 13' | 20' | 14' 8" | 6' | 33' 8¾" | 10' | 4' 6" | 7' 3" | .. | 16 |
| 17. | Joliet No. 3; same as above..... | 322 | 1,545* | 3,290 | 12,316 | 17,151 | 84' 0¾" | 14' | 21' | 15' 6" | 5' | 37' 7" | 10' | 4' 6" | 7' 6" | .. | 17 |
| 18. | Rosena ..... | 388 | 1,250 | 2,850 | 15,210 | 19,310 | 97' 0¾" | 13' | 20' | 16' | ..... | 59' 6¾" | 15' | 4' 10¾" | ..... | 16 | 18 |
| 19. | Edith; Allegheny, Pa.; Am. St. & Wire Co..... | 388 | 1,324* | 2,849 | 15,990 | 20,163 | 97' 0¾" | 13' | 20' | 16' | 5' 10¾" | 56' 8¾" | 12' | 4' 10¾" | 7' 10¾" | .. | 19 |
| 20. | Central Nos. 1 & 2; Cleveland, Ohio; Am. St. & Wire Co..... | 435 | 1,644* | 2,112 | 16,836 | 20,592 | 90' | 15' 6" | 22' | 15' | ..... | 61' 10¾" | 8' 5¾" | 4' | 7' 6" | .. | 20 |
| 21. | Central No. 5; same as above..... | 450 | 1,580* | 3,349 | 16,789 | 21,718 | 97' 2¹¹/₁₆" | 14' 6" | 21' | 15' 6" | ..... | 58' 0¹¹/₁₆" | 9' 10" | 4' | 7' 6" | .. | 21 |
| 22. | South Works, No. 9; South Chicago, Ill.; Federal Steel Co..... | 460 | 1,953* | 3,471 | 17,274 | 22,698 | 98' | 15' 9" | 22' | 16' | 8' | 43' 6" | 14' | 4' 6" | 7' 6" | 11 | 22 |
| 23. | South Works No. 10; same as above..... | 460 | 1,940* | 2,870 | 18,347 | 23,163 | 95' | 15' 6" | 22' | 16' | 10' | 43' 6" | 14' | 4' 6" | 7' 6" | 11 | 23 |
| 24. | Neville; Neville Island, Pa.; Am. St. & Wire Co.... | 462 | 1,575* | 3,305 | 17,295 | 21,835 | 100' | 15' | 21' | 15' 6" | ..... | 60' | 10' 9" | | 4' | 7' | 16 | 24 |
| 25. | Lorain No. 1; Lorain, Ohio; National Tube Co..... | 484 | 1,420 | 4,825 | 16,400 | 22,645 | 100' | 14' 6" | 22' | 15' | ..... | 63' | 10' | | 4' | 7' | 16 | 25 |
| 26. | Lorain No. 2; same as above..... | 484 | 1,320 | 5,025 | 18,000 | 24,345 | 100' | 14' 6" | 22' | 15' | ..... | 62' 9" | 10' | | 4' | 7' | 16 | 26 |
| 27. | Newcastle No. 4; Newcastle, Pa.; Carnegie Steel Co. | 500 | 1,500 | 3,376 | 21,210 | 26,086 | 106' 2" | 15' | 23' | 17' | ..... | 67' | 15' | | 5' | ..... | 16 | 27 |
| 28. | Ohio Nos. 1 & 2; Youngstown, O.; Carnegie Steel Co. | 565 | 1,500 | 4,505 | 21,310 | 27,315 | 106' 5⅝" | 15' | 23' | 17' | ..... | 67' 3⅝" | 15' | | 5' | ..... | 16 | 28 |
| 29. | Ohio No. 3; same as above..... | 565 | 1,710 | 3,205 | 21,700 | 26,765 | 106' 6" | 16' | 23' | 16' | ..... | 72' 2¾" | 15' | | 5' | ..... | 16 | 29 |
| 30. | Mingo Nos. 2 & 3; Mingo Junction, Ohio; Carnegie Steel Co..... | 565 | 1,710 | 3,220 | 21,600 | 26,540 | 106' 6" | 16' | 23' | 16' | ..... | 72' 2¾" | 15' | | 5' | ..... | 16 | 30 |

*Includes volume of hearth-sole. †Six inches diameter.

## Local Districts for the Conservation of Natural Resources.

Sir: Without attempting to reply to the question, "How May the First Steps in Conservation Be Taken?" propounded editorially in your issue of Jan. 7, the writer begs leave to suggest one or two things which he has not thus far seen in print, in the hope that discussion may be elicited.

We are very wasteful in our methods of producing power. We are making vast inroads upon our fuel supplies, which should be conserved, and we are permitting other sources of power to pass by us unused. Coal, gas, oil, and vegetation, are but stored sunshine, and each day sufficient water is evaporated from the earth's surface by the sun's heat, and elevated to form clouds from which it is precipitated, to water the earth and render it habitable. If the rainfall be conserved, and its weight utilized in developing power, as it descends from the uplands to the sea, the amount of energy practically available would be far in excess of all the power now developed at such fearful cost of fuel. The place to begin the conservation of the rainfall is as close to the plateaus near the sources of the tributaries which unite to form the larger streams and navigable rivers as is practicable. A method of accomplishing the work would be for the residents of any suitable valley or drainage area, to unite in forming a conservation district embracing any convenient area from 200 to 3,000 sq. mi., the boundaries being determined by topographical rather than political divisions.

When some farmer's boy returns from college, harnesses a small stream to an electric generator with which he lights the buildings, saws the wood, cuts the feed, shells the corn, drives the fans, the churn, the sewing machine, the pump, and charges storage batteries and rides in his own automobile, the neighbors will take notice. They may meet at the school house, or town hall and learn that the people of any valley

can unite and, by obtaining proper authority, which may require legislative action, can form a Conservation District, with power to levy taxes and issue bonds, and, through executive officers, transact all the business required for the conservation and utilization of natural resources of the district. These districts would coincide with drainage areas. The people residing within the district, both those living in the country and the towns, could be provided with water, light and power, at such rates as would be found adequate to meet the cost of installing and maintaining the requisite plants and administering the business. The commissioners or trustees, having the right of eminent domain, could protect, or even appropriate forests, and derive revenue therefrom. Such water powers as were found existing upon the streams within the district could be appropriated, or allowed to remain, as should be found to be expedient.

The owners of the land within such districts could probably maintain their rights to the minerals contained within the side lines of their lands. If existing laws are inadequate to prevent them from mining either in a dangerous or wasteful manner, then the laws should be revised. If the mining operations are being properly conducted, they should not be disturbed. If the development of water power lessens the demand for other fuels, let the water power be utilized, and other fuels conserved.

In so far as the writer is informed, the question as to whether or not an individual, or corporation has the right, upon the acquisition of a few acres of land, either by lease or purchase, to sink wells in his, or its property, and drain the oil or gas from beneath contiguous territory for unknown distances, has never been adjudicated. The practice is common, but it is so averse to ordinary justice, that, if no law exists to prevent it, one should be made to fit the case.

The occurrences described in your issue of Jan. 7 regarding the so-called "development," which should be named "destruction" of two oil fields, would not be permitted in any well regulated conservation district, but would be prevented by drastic measures, if necessary. As the laws now exist, the local authorities cannot prevent such frightful waste. It is caused by the scramble for dollars by the adventurers and speculators, and when "developed," the great octopus gets the most of the dollars that are saved, without incurring any legal responsibility for the values which are destroyed. The only remedy which the writer can suggest is to place the control of the property, for all time, by some such organization as is herein suggested, in the hands of the commissioners or trustees, who would be able and competent to cope with an influx of oil, or gas prospectors, and who would hold it for the uses and benefits of the people now owning it, and there need be no unseemly haste about its development.

Such a method would not prevent the prospector for oil or gas from being properly remunerated. On the contrary, it would protect him, but it would more efficiently protect the land owner, and would even secure to great corporations their legitimate rights to obtain these natural resources, without incurring hazardous expenditures, and would conserve and utilize such resources, without reckless and useless waste.

Assuming that such conservation districts were formed, that the plans were carefully studied, the works skillfully executed, and the business honestly and systematically administered, it is plain that the rainfall would first be impounded in reservoirs of modest dimensions as near to the upper plateaus as suitable sites could be obtained, so that water supplied to the inhabitants of those higher levels would require the least lift for the pumps, and so that the greatest practicable quantity could be delivered by gravity to the lower levels.

The problems to be solved in each district would be determined by the topography of that district, and the power economically available would be determined by the solution of those problems, when the rainfall, the run-off, and the effective heads under which it could be used had been determined. Inasmuch as it is presumed that all of the works would be above navigable channels, it is plain that no dams, or reservoirs of extraordinary dimensions would be required, and that the success of each venture would depend largely upon skill in designing and painstaking detail in execution.

Since man has not, as yet, learned to control the atmospheric conditions which cause precipitation, it follows that there will be times of excessive rainfall, and seasons of continuous deficiency, so that while plans may be made for conserving the mean annual rainfall, extremes must be provided for, without endangering the stability of structures upon one hand, or the reliability of supply upon the other. So soon as a few instances of reasonable success shall be shown, the number of conservation districts will rapidly increase, and newly fledged engineers, and the latest fake oil "Engineering Companies," as well as county surveyors, will come forth as conservation engineers, and the commissioners may not always obtain the best technical advice. Therefore it will be well to have a state board to pass upon the adequacy of plans and specifications, before works are constructed involving elements of danger, or needless waste. In fact, the conservation might begin with the state board, which would commission the local engineer, after due examination, and approve his maps and plans, after thorough investigation.

At any rate, it is time to begin actual work in conserving and utilizing the rainfall in some form, and that form which begins near the source of the stream and uses its power where it is readily controlled by works of moderate cost, will obtain better results than the one which attacks the greater problem of controlling the larger stream by the greater works, in efforts to recover the energy which the water has wasted in descending from the highlands.

In every case careful estimates of cost and of revenue should be made, unprofitable schemes should not be undertaken, and such resources as could be profitably developed should be utilized by the people to whom they belong without paying tribute to great corporations, or yielding rights and franchises, without either reserving control, or deriving benefit therefrom. Such wealth as is to be derived from the conservation and utilization of the rain that falls upon the land belongs to the owner of the land as unquestionably as does the grass which grows upon it, and if the owners will but unite in causing it to be secured to them by safe and sane methods, they will learn that its fruits can be harvested by them as surely as the other products of their farms.

Time will be required to educate farmers and others in the advantages to be gained by them in adopting such methods as are above indicated, and opposition may be expected from power companies, but if the state governments, and the United States Government, especially through its new Country Life Commission, should see fit to favor such a beginning as is above indicated, it will be found that the more general it becomes the more admirably it will fit in with any works that may be planned for the improvement of navigation, the lessening of Flood Damages, the Conservation of the Soil, and the betterment of conditions surrounding Life in the Country.

M. D. Burke.

18 E. 4th St., Cincinnati, O., Jan. 20, 1909.

[Our correspondent's plan for local conservation districts is interesting and seems worthy of consideration. No little care would be required to work out a scheme that would meet the economic and political conditions of the rural sections of the country, to which we assume this plan would more particularly apply. One of the greatest obstacles to rural progress is the hesitancy of the farmer to enter into really effective cooperative enterprises. People of the rural districts are to a large degree unused to administrative functions and they have yet to learn the value of the services of technically trained men. Without the services of such men, obviously, conservation districts could not succeed.

It seems likely that a careful study of the experiences of California irrigation districts would bring out information of value to any one who should set about the formation of conservation districts or the drafting of laws making this possible.—Ed.]

## The Need for a General Service Corps in the Conservation of Our Public Utilities.

(AN APPRECIATION OF THE ENGINEER AS A CITIZEN.)

Sir: Believing that discussion may be of service in influencing our legislators and statesmen, as well as our humbler selves, to avoid the world-old error of putting the cart in front of the horses, I hope to see editorial comment, as well as friendly suggestions from the profession at large, bearing upon the modus operandi of evolving the best and broadest general service corps.

If the pledges of the two great political parties are worth the paper they are written on, and if it is desired that the projected $500,000,000 worth of works (figures quoted without prejudice) shall draw their governing ideas from the best and broadest sources, then before we begin leading discussions of one type of work versus another and the total amount of working capital needed, is it not well that we give a few thoughts to the method of evolving the human machine that must do the work?

With the need of a general service corps granted, we are face to face with the question of how it may be assembled. It goes without saying that all men will hope to see such a service corps organized that it will acquire strength from every source—that the workers may pull together and reduce to a minimum the bickering and caterwauling that has accompanied some great works.

Engineers must be called from every branch of the profession, they must come with a willi[illegible]s to amalgamate as men striving together for the g[illegible]st good.

If as engineers we cannot come togeth[illegible] the common good, we are deserving of less respe[illegible]n the half clad, unfed Indian peons who in blind [illegible] faith, following the fanaticism of Cortez and the [illegible]res, toiled together to build the great white church[illegible]fronting on the plazas of cities of adobe mud in the G[illegible] Valley of Mexico. Perhaps their toil was ill-advised, [illegible] the building of those temples that gleam like silv[illegible] the sun was better for the race than idleness [illegible] occasional spasms at throwing together unplanned h[illegible] of puddled clay.

We must not forget that in the era now [illegible]ning, the work which the engineer must do is man[illegible]ded. Coworkers must come from all branches of [illegible] profession and offer the best that lies within them for the building up of the perfect machine.

The engineer will be a star performer [illegible] the new world's theater of operations where the curtain is about to rise. To accuse him of being so preoccupied with his daily multiplication table of minute detail that he is willing to be a blind follower of the press bureau publicists and of statesmen who take to themselves the task of formulating the plans for the whole works is to accuse the engineer of not knowing his calculus of life. It would be equivalent to charging him with the crime of being asleep at the switch that leads to the opportunity of a thousand years.

From coal-heavers to President the nation agrees that we must get busy. We are to redeem our waterways, our deserts and our swamps, put the rivers to work, conserve our forests and our unmined coal, not to mention the reconstruction of an indefinite number of thousands of miles of railroads, the building of transcontinental-interoceanic terminals and metropolitan transportation systems to cope with the unparalleled congestion of city traffic.

The engineer will play his part, but must he wait like the patient ass to be loaded and driven by his master or will he take it upon himself to lift up his voice and tell the world that he has at last concluded to be something of a master-planner, as well as a builder and a bearer of burdens?

Is it for the profession to await the dominant word of the layman or shall those who must reconnoiter, plan, specify, direct and agonize over the building of the works stand out in the open and lay down their dictum?

"There is of course no elbow room for the dilettante, the self-seeker or the ancient order of clock watchers in our company. If in the measure of a thousand years a human life is but a day, then we who are about to die salute you. We will give you the best we have, but we are those who must carry on the work through the eternal changing of the grave-yard shifts. The work is hard, but we do it singing, asking only that we may draw our brains and blood and sinews from east and west and north and south wherever the strong man may be found. Grant us this right our countrymen, that we may build the perfect structure, for the day is short, and we want no limit to the strength of our endeavors, save the limit of the cradle and the grave."

The day has gone by when it can be said in truth that the typical song of the engineer is, "Everything Going Out and Nothing Coming In." We must make both ends meet, must figure on returns from trade before we build, that trains may continue to run and that our canals may be kept clean.

It must not forever be a taunt that the engineer is a magnificent spendthrift who walks with his head in the clouds and his feet too seldom on mother earth—a dreamer of dreams who must be the first to go hungry when the panic strikes and the first to be chloroformed after the age of forty. The general service corps which conserves our national resources must be drawn from every service where men are taught building, salvage and operation, if the manifold problems confronting us are to be solved and a Q. E. D. marked up to our credit.

It is a sign of pitiful misunderstanding of the engineer as a man, for any individual to make the sweeping assertion that the engineers of any service or company or corps are per se, by reason of some supposedly previous condition of servitude, unfitted to assist through the years to come in the building of this nation's unmeasured utilities.

There are good men in the Reclamation Service, good men in the Isthmian Canal Service, in the Corps of Engineers of the Army, in the growing departments of the transcontinental railways, in the Forestry Service, in the subway service of the Metropolis, as well as in the municipal works of the big cities.

There are works where the magnitude of the task seem to overburden the powers of a single man even though he be cast in heroic mold. Two men of parts gave up their work at Panama after carrying heart-breaking burdens while simultaneously striving to maintain a perfect record and satisfy the auditing of the books of the War Department, and this in a strip of territory less than one hundred miles long. The Corps of Engineers seems to have been the only body of men broad enough and staunch enough to work together and stay on the job.

In a dozen western states for some six years a host of willing toilers have been building canals and dams and

driving tunnels in temperatures ranging from where the mercury freezes solid to where it registers 128° in the shade. The work of the Reclamation Service has been unheralded in Boston and New York and is hardly known in the temples of learning in the self-centered east and south.

The Reclamation engineers, incidentally, have been husbanding the money coming in, as well as guarding the dollars going out. To insure the perpetuity of the communities of agrarian interests which are being born in the arid places, the service has been put to it to make the new settlements self-sustaining in the most complete sense of the term.

Model towns have been built, Gordian knots have been cut in skeins and skeins of priority water-right entanglements. The engineers working together with Mr. Pinchot's forestry experts have done their best to supplement the irrigated farm units of their lateral distributing systems with free mountain range for the cattle of those who will have their homes on the grain and fruit farms.

If we can believe two congresses of state governors, the cost of the work of salvage of the nation's resources will exceed in magnitude the sum total expended on the Panama Canal, the Reclamation Service, the New York railroad terminals, her subways and her new waterworks by many millions of dollars.

If a general service corps is organized it must be with an esprit de corps broad enough to cover the personal idiosyncracies of the straightest standing Corps of Engineer man who ever earned his shoulder straps by leading his class at West Point, as well as the cantankerous sins of the best steel-trap brained civil engineer who never wore a tag.

To condemn by the wholesale by a sweeping assertion that the men of a corps are not available for the master-service of the nation in the years to come is stating an absurdity of such proportions that it destroys itself.

Among the fighting drivers of works in the nation's pioneer construction days, when it was the work of a life time to lay two streaks of red rust across the continent, it was the custom in some quarters to fire on the spot every man who blundered.

But the day of the brute is on the wane. We are beginning to learn from the errors we made ourselves, and we are beginning also to learn that when we can find an intelligent and loyal man who has made mistakes, recognized and buried them and reconstructed the wreck, we have a man to be valued. And what is true of the one man is true of the many.

Every great organization has made great mistakes. The Pennsylvania Railroad has made its blunders, so has Mr. Harriman, so has the Corps of Engineers, so has the Reclamation Service. So has a certain great statesman to whom we all take off our hats. But no one man or organization is thick-headed to the degree of making the same set of blunders a second time.

The team work is the thing. The general service corps (and any other name will do as well) is coming. The engineer owes to the nation the best service he can offer, in this, the dawn of a new national life.

James Concrete Steele.

Cuba, Dec. 26, 1908.

## Notes and Queries.

A correspondent writes requesting that our readers furnish him with a formula for the design of motor (clock-work) springs.

In Prof. Cain's article "Conventional Live-Load Positions for Maximum Stresses in Arches," printed in our issue of Feb. 2, 1909, the drawing on p. 127 should show the 8-ft. rise as the rise of neutral axis, i. e., the rise from center of rib at springing to center of rib at crown. The drawing as printed erroneously shows this dimension as though it were measured to the soffit.

In the article entitled "Comparative Estimates for Different Types of Bridges for the Same Crossing," in our issue of Jan. 28, 1909, p. 98, we said

In investigating the project, thirteen different forms were completely studied and their respective costs are noted.

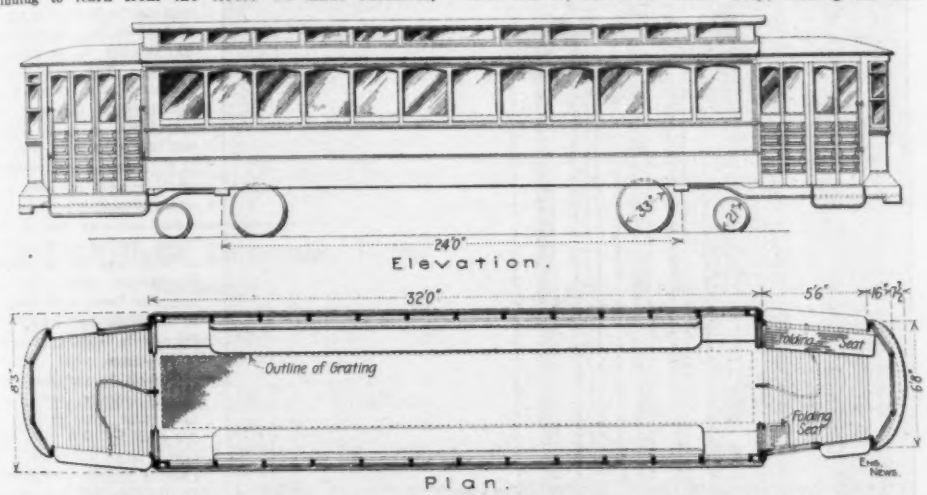
Mr. Mason R. Strong takes a valid exception to this and says

The use of the word "completely" seems hardly fitting, as the table apparently shows the first cost only, with absolutely no reference to maintenance or sinking fund charges.

## A Light "Prepayment Type" of Street Car; the Standard Adopted by the Metropolitan Street Ry., New York City.

The latest development in that line of street cars, popularly called the "pay-as-you enter" kind, is in the adaptation of the idea for new equipment of the Metropolitan Street Ry. Co., New York City. It is stated that plans for remodeling the present equipment of closed and open cars, particularly the former, to secure the benefits of the fare-prepayment scheme are under consideration, but no conclusion has been reached. The trial service with 155 heavy cars instituted over a year ago on the Madison Ave. line of this company was noted in Engineering News, Nov. 21, 1907.

While these cars were successful in the ways expected, at the same time it was felt that the great weight led to an extra expense in operation and maintenance that was unwarranted. After tests and studies by Messrs. Ford, Bacon and Davis, of New York City, acting as Consulting Engineers, the design shown in the accompanying figure was evolved as a desirable compromise between the heavy prepayment car and the lighter double-truck car in general use.




FLOOR PLAN AND ELEVATION. NEW STANDARD CAR OF THE METROPOLITAN STREET RY., NEW YORK CITY.

The total weight per seat of the first prepayment cars (empty) was about 1,330 lbs. against 790 lbs. for the more common double-truck closed car. The former was equipped with four 40-HP. motors and the latter with two of 55 HP. each. The weight per seat of the new car (empty) is reduced to some 800 lbs. The great weight per seat of the earlier cars is due to the large platforms and an arrangement of doors such that six seats per car are lost.

The investigations of Messrs. Ford, Bacon and Davis showed that the speed of loading and unloading the prepayment cars was slightly higher than with the ordinary closed car, although at best only about half the rate attained with the open cars having cross-seats. The current consumption, in watt-hours per ton-mile, was found to be about 10% higher in the four-motor prepayment car than in the two-motor double-truck closed car. This seems to show that the current consumption per (seated) passenger mile of the older prepayment car is about 1.72 times that of the ordinary double-truck closed car.

In the new design the car body has been left open to the platform except for sliding doors. The swinging doors of the older design have disappeared and the bulkhead between car body and platform is reduced to a mere stanchion to separate the entering and leaving passengers. As shown in the accompanying figure, the seats at the ends of the car are made with straight backs and narrow bottoms. The paneling under the narrow bottoms is removed, so that the passengers may draw their feet in under them. Folding seats are let down in the front platform, making the total seating capacity 47. The rail, normally in position on the rear platform to separate the entering from the leaving passengers, can be slid up to the roof on three pipe stanchions, when the direction of the car is reversed.

The plan and elevation of the new car is reproduced through the courtesy of Mr. Oren Root, General Manager for the Receivers, Metropolitan Street Ry. Co. A fuller account of the studies of Messrs. Ford, Bacon and Davis is printed in the "Electric Railway Journal," Dec. 5, 1908.

The general success of the "prepayment idea" in surface cars is attested by the adoption of the new design by the Third Avenue Ry., New York City. The Philadelphia Rapid Transit Co., it is reported, will reconstruct all their heavy closed cars to conform to this design. The Capital Traction Co. and the Washington Railway and Electric Co., of Washington, D. C., will add the new type of cars to their equipment during the present year.

A SHARP CONTROVERSY has arisen between the Federal Court receivers for the Metropolitan Street Railway Co. of New York City and the Public Service Commission. The latter, it seems, has found the receivers unresponsive to its orders or suggestions for improving the street-car service. The receivers, A. H. Joline and D. Robinson, finally complained to the Commission that its orders were oppressive and that the receivers would farther disrupt the street-railway system if the Commission persisted in its course. Chairman W. R. Willcox thereupon wrote a sharp rebuke to the receivers, on the part of the Commission. Later the receivers retorted, still more sharply. Specimen extracts from the two letters are interesting:

Commission to Receivers:

The Commission notes with astonishment the veiled threat in your letter that if this Commission insists upon compliance with the statute and with the orders of this Commission, you will continue your policy of breaking up the street railroad system of Manhattan into small sections. Neither this statement nor any similar one will induce this Commission to disregard the law or knowingly allow any one else wilfully to do so. In carrying out the policy of disruption you may be within your legal rights, provided the United States Court is willing to assume the responsibility for your acts, but you cannot shift the responsibility therefor upon this Commission. . . . If compliance is not had with these orders, proceedings will be begun in the courts to enforce penalties.

Receivers to Commission:

Suggestions or insinuations on your part that we have either violated the law in the past or intend to do so in the future are utterly without foundation. We are rendering the best service in our power, and neither the orders of your Commission nor the statutes of the State of New York can require us to do anything more. * * * Fortunately, there are tribunals which consider evidence, have regard for existing facts and are guided by the settled rules of law. If you undertake to destroy the value of the property in our charge we will, of course, resist you by every lawful means in our power. * * * As to the matter of non-appearance before your Commission upon the hearings, you may possibly remember that at an early stage of the case we were directed by the court not to appear, but to furnish you with any and all information which you might require. * * * Your reference to "threats" is without justification. We make no "threats," but simply tell you what is certain to come to pass if you persist in the policy which you have adopted. You have wholly failed to meet any material assertions or suggestions made by us in our letter to you and we are therefore justified in assuming that you are unable to answer them.

The situation as to the street-railway receivership in New York City was characterized by us editorially in its early stages (Eng. News, Oct. 3, 1907; Oct. 17, 1907; Aug. 27, 1908; Sept. 17, 1908). The general opinion is that it has by no means improved since then, and the public has been deprived of transfers at most of the intersections and has received no improved service. The court referred to in the above extracts is the court of Federal Judge Lacombe.

The situation promises to clear up shortly, as the Metropolitan has been ordered sold under foreclosure.

## The Government 5,000-ton Hydraulic Compression Testing Machine.*

By RICHARD L. HUMPHREY,† M. Am. Soc. C. E.

A vertical compression testing-machine of ten million pounds capacity is being constructed for the Structural Materials Testing Laboratories, United States Geological Survey, by Tinius Olsen & Co., Philadelphia, Pa. This machine, having a gross weight of over 200 tons and an extreme height above foundation of about 80 ft., is the largest testing-machine ever constructed.

The machine was primarily acquired for the purpose of testing large blocks of stone made necessary by the study of the building stones of the country, as requested by the Supervising Architect. It was deemed desirable to study the effect of flaws and defects of the various kinds in large blocks of natural stone, for which purpose a machine of this capacity was determined upon. In order to care for a further request of the Supervising Architect for data relative to the strength of structural columns of brick and concrete, as well as of structural steel, the original clearance between heads was increased from 25 to 65 ft. Already the need for this machine in the investigation of built-up structures is established through the urgent requests for its early completion.

Some idea of its size may be obtained from the accompanying illustration in which has been sketched one of the chords of the Quebec Bridge which collapsed, and a still larger chord from the Blackwell's Island Bridge. It is readily apparent that this machine is capable of testing built-up structures of even greater size than those referred to.

The following brief description has been prepared because of the interest which has been manifested, and in response to the frequent requests which have been made for information concerning the machine.

The machine is a large hydraulic press, with one adjustable head, and a weighing system for recording the pressures developed in it by means of the triple plunger pump. It has a maximum clearance between heads of 65 ft.; the clearance between the screws is a trifle over 6 ft., and the heads are 6 ft. square. The base of the machine contains the main cylinder with a sectional area of 2,000 sq. ins., upon which rests the lower platform or head, provided with a ball-and-socket bearing. The upper head is adjustable over four vertical screws 13½ ins. in diameter and 72 ft. 2 ins. long, by means of gearing operating four nuts with ball bearings upon which the head rests. The shafting operating this mechanism is connected with a 15-HP. 220-volt variable-speed motor which operates the pump of the main cylinder.

The weighing device consists of a set of standard Olsen levers, upon which is weighed 1/80 of the total load on the main cylinder. This reduction is effected through the medium of a piston and diaphragm. The main cylinder has a diameter of 50 ins. and the smaller a diameter of 5⁹/₁₆ ins. The weighing beam is balanced by an automatically operated poise weight and is provided with a device for applying successive counterweights of 1,000,000 lbs. each. Each division on the dial is equivalent to a 100-lb. load; smaller subdivisions are possible by means of an additional needle beam.

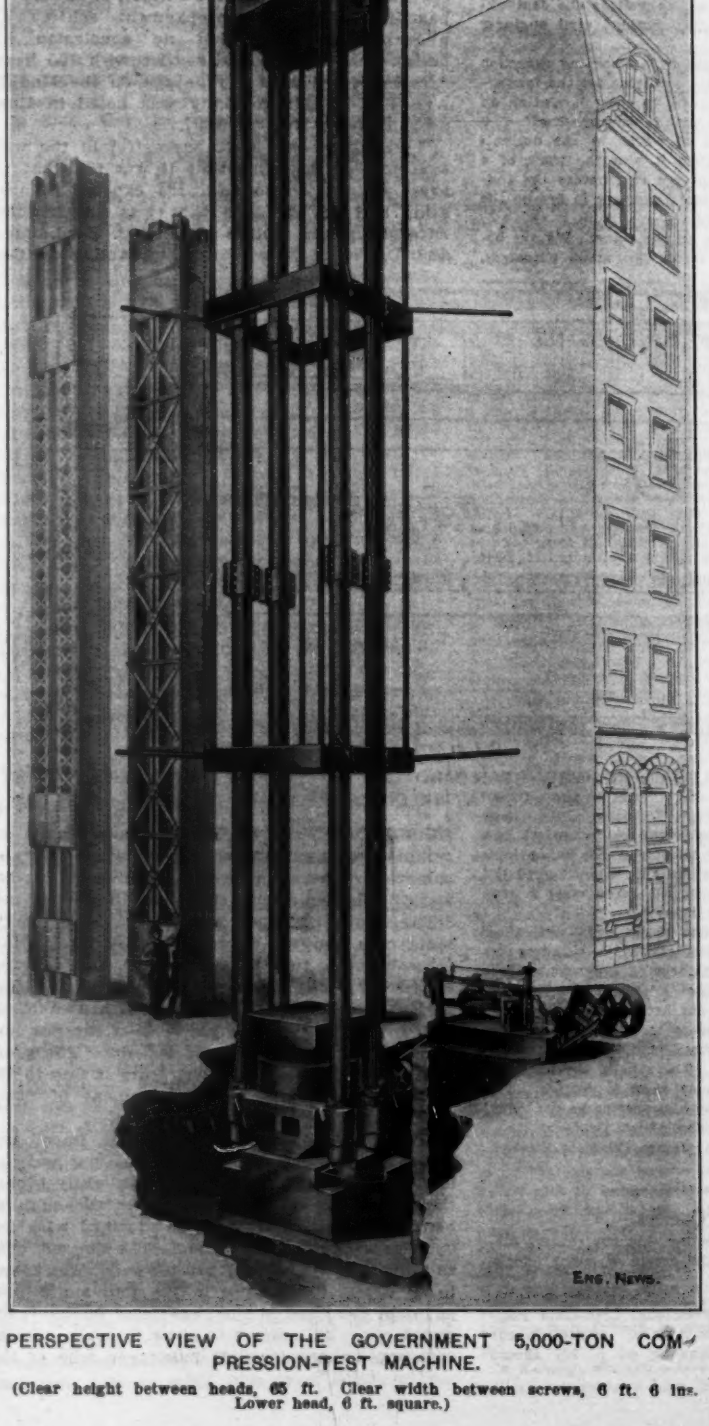
The extreme length of the main screws necessitates splicing, which is accomplished as follows:

In the center of the screws at the splice is a 3-in. threaded pin for the purpose of centering the upper and lower screws, and surrounding the splice are split sleeve-nuts, which are easily removed whenever it is necessary to lower the upper head, and as easily replaced.

In order to maintain a constant load a needle-valve has been provided which, when the pump is operated at its lowest speed, allows a sufficient quantity of the oil to flow into the main cylinder to equalize whatever leakage there may be.

The main cylinder has a vertical movement of 24 ins. The speed of the machine for purpose of adjustment, using the gearing attached to the upper head, is 10 ins. per minute. The speed for applying loads, controlled by the variable-speed motor driving the pump, varies from the minimum of at least 1/60-in. per min. to a maximum of at least ½-in. per min. The contract provides that the machine shall have an accuracy of at least one-third of 1%, for any load over 100,000 lbs. up to the capacity of the machine.

Some idea of the size of the machine may be obtained from a statement of the weight of its principal parts. The castings for the base and the top head weigh approximately 50,000 lbs. each, each main screw will weigh over 40,000 lbs., the lower platform about 25,000 lbs., and the main cylinder 16,000 lbs. The top of the machine will be about 70 ft. above the floor, and the concrete foundation upon which the machine rests will be about 8 ft. below the floor line.




PERSPECTIVE VIEW OF THE GOVERNMENT 5,000-TON COMPRESSION-TEST MACHINE.

(Clear height between heads, 65 ft. Clear width between screws, 6 ft. 6 ins. Lower head, 6 ft. square.)

*Published by permission of the Director of the U. S. Geological Survey.

†Engineer in Charge, Structural Materials Testing Laboratories, U. S. Geological Survey.

## Congress Bill for an 11,000-ton Emery Testing-Machine.

A proposal for a testing-machine twice as large as the 5,000-ton Olsen machine now in use by the Geological Survey is contained in a bill introduced in Congress a few days ago. The bill is now before the Senate's Committee on Appropriations. It specifies a machine of 11,000 tons capacity in compression, and 5,500 tons in tension, taking members up to 100 ft. long. A. H. Emery, of Stamford, Conn., is named as designer and builder, and the price, including the machine and two 80-ton cranes, is fixed at $1,750,000. Appropriation for a building to house the machine is also provided, the available sum here being $200,000.

Those parts of the bill which describe the machine are as follows:

This machine shall be equal to or superior in accuracy, ease of working and durability to the celebrated Watertown Arsenal machine which was invented, designed and built by him [Emery].

It shall be built according to the designs which have already been prepared by him after consultation with the largest bridge builders of the country as to the size of the bridge members and other work to be tested by it, which design has been shown to several of the best engineers of the country for criticism and approval by them.

It shall be able to give and weigh loads of tension up to 5,000,000 kg., or 11,000,000 lbs., and loads of compression up to 10,000,000 kg., or 22,000,000 lbs., on specimens up to 100 ft. or more in length. The main loading platforms for testing bridge compression members, columns, and so forth, shall be not less than 8 ft. wide and 12 ft. long and shall be adapted to receive auxiliary holders and platforms.

The machine shall be provided with tension holders, to seize and test to destruction round, square, and rectangular bars, with loads up to 1,500,000 kg., or 3,300,000 lbs., with lengths up to 100 ft. or more.

It shall be provided with a pair of holders, together with their pins and bushings, as designed by him, for testing bridge links up to 100 ft. or more in length, with all loads up to 5,000,000 kg., or 11,000,000 lbs.

It shall be provided with an auxiliary pair of compression platforms with hardened faces for testing stone, and so forth, with all loads up to 10,000,000 kg., or 22,000,000 lbs.

It shall also be provided with a pair of auxiliary platforms, with pins 24 ins. in diameter and 8 ft. long, for testing pin-ended columns with loads up to 10,000,000 kg., or 22,000,000 lbs.

An explanatory statement by Senator Teller, accompanying the bill, refers to the great benefits derived from the Emery 800,000-lb. testing-machine at Watertown Arsenal, and the very much greater benefits which the proposed machine promises. The failure of the Quebec Bridge compression chords is mentioned, with the remark that had they been tested before-

hand their weakness would have been known in time. The statement further describes the proposed machine thus:

The main part of the machine as designed is about 153 ft. long, while the concrete foundation is about 200 ft. long, 30 ft. wide, and 15 ft. deep, and the metal work in these foundations about 192 ft. long. The width of the machine is about 25 ft., and it will require for its erection and use two cranes of 80 tons capacity each.

The weight of the metal work of this machine, including its accessories, cranes, and the metal work of their ways, will be when finished nearly or quite 3,500 tons, mostly of steel, and a large part of this machine has to be of unusually good workmanship and generally much better and more accurate than has been put in any very large machine of any kind whatever.

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THE ANTHRACITE COAL deposits of Pennsylvania will be exhausted in a little over a century, according to the testimony of William Griffiths, of Scranton, Pa., in the suit brought by the Government against the anthracite coal carrying railways under the Sherman Law. Mr. Griffiths' testimony gave the future supply of coal for shipment to the markets under the control of different railway corporations in substantially the following proportions:

Delaware, Lackawanna & Western, 6.55; Delaware & Hudson, 2.29; Erie & Wyoming Valley, 1.82; Erie Railroad, .77; New York, Ontario & Western, .28; New York, Susquehanna & Western, .54; Delaware, Susquehanna & Western, 1.38; Pennsylvania, 6.24; Central of New Jersey, 17.35; Lehigh Valley, 16.87; Philadelphia & Reading, 42.25; uncontrolled, 3.71.

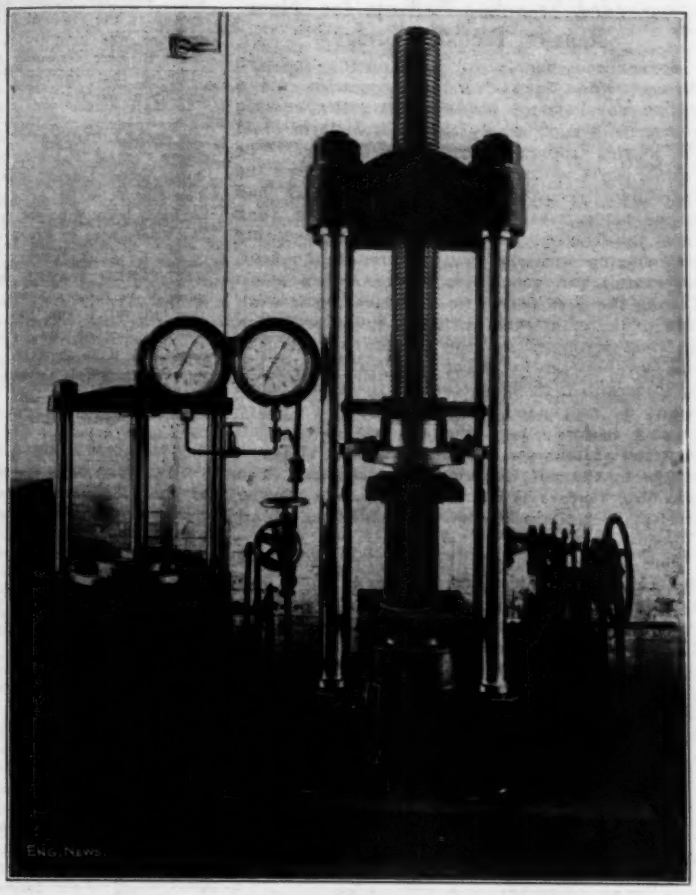


FIG. 1. PUMP, INTENSIFIER AND PRESS, COMPRISING THE 500,000-LB. COMPRESSION TESTING MACHINE OF THE NEW YORK BOARD OF WATER SUPPLY.

## A 250-Ton Hydraulic Compression Testing Machine.

By JAMES L. DAVIS,* Assoc. M. Am. Soc. C. E.

For the work of the laboratory of the Board of Water Supply of the City of New York a machine was desired chiefly for testing plain concrete in compression and having a capacity of 500,000 lbs. In consideration that in a series of similar concrete specimens, individual specimens may vary in strength 20% or more from the mean, a type of machine giving errors not exceeding 5% was allowable, if thereby a considerable saving in cost, weight of machine, or room occupied could be effected. The desired machine was required to take specimens up to 12 ins. square in cross-section and up to 40 ins. in length. The crushing head was to have a spherical bearing.

The writer thinks that a description of the machine finally evolved and of the preliminary studies is of interest and is of at least remote bearing on the question of testing huge bridge members which is being revived at the present time.

TESTS OF FRICTION IN A HYDRAULIC CYLINDER.—For a preliminary investigation of the accuracy of hydraulic machines, the manufacturers submitted a cylinder and ram, from a small testing machine, which had seen some service, for experiment. The cylinder was fitted with a copper lining and was packed in the manner proposed for the large machine. This cylinder, to which an accurately adjusted gage and hand-operated pump were attached, was placed in a 100,000-lb. screw-power, automatic-beam Riehle testing machine in the manner of an ordinary compression specimen. Maintenance of the pressure in the cylinder was facilitated by the pump, and a series of gage pressures, and simultaneous beam readings was observed. The diameter of the cylinder was 3.027 ins., and the area was 19.85 sq. ins.

Table I. gives the results with the load both increasing and decreasing. The readings are the means of two observations. The poise was controlled by hand, and the load applied in successive increments or decrements.

Table II. gives the results of a series of readings with load continuously increasing at slow speed, and poise moving automatically. Under these conditions readings are difficult, and correspondingly less reliable.

The maximum individual error occurs with the low pressures. The maximum average error occurs with the load increasing, and it is under this condition that the machine is ordinarily used in testing.

TABLE I.—TEST OF FRICTION IN A HYDRAULIC CYLINDER. HAND POISE.

| Gage Reading. | Beam Reading Load Increasing. | Per cent of Error. | Beam Reading Load Decreasing. | Per cent of Error. |
|---|---|---|---|---|
| 9,930 lbs.... | 9,460 lbs.... | +5.0 | 9,580 lbs.... | +3.6 |
| 19,850 " .... | 20,010 " .... | −0.8 | 19,985 " .... | −0.7 |
| 29,780 " .... | 29,420 " .... | +1.2 | 29,640 " .... | +0.5 |
| 39,700 " .... | 39,720 " .... | .0 | 40,075 " .... | −0.9 |
| 49,630 " .... | 49,210 " .... | +0.8 | 49,975 " .... | −0.7 |
| 59,550 " .... | 59,010 " .... | +0.9 | 59,745 " .... | −0.3 |
| 69,480 " .... | 68,520 " .... | +1.4 | 69,400 " .... | +0.1 |
| 79,400 " .... | 78,400 " .... | +1.3 | 79,185 " .... | +0.3 |
| 89,370 " .... | 88,305 " .... | +1.2 | 89,210 " .... | +0.2 |
| | Average.. | +1.2 | Average.. | +0.2 |

TABLE II.—TEST OF FRICTION IN A HYDRAULIC CYLINDER. AUTOMATIC POISE.

| Gage Reading. | Beam Reading Load Increasing. | Per cent of Error. |
|---|---|---|
| 9,930 lbs..... | 9,800 lbs..... | +1.3 |
| 19,850 " ..... | 19,800 " ..... | +0.2 |
| 29,780 " ..... | 28,570 " ..... | +4.2 |
| 39,700 " ..... | 39,800 " ..... | −0.3 |
| 49,630 " ..... | 48,000 " ..... | +3.3 |
| 59,550 " ..... | 58,800 " ..... | +1.2 |
| 69,480 " ..... | 69,600 " ..... | −0.2 |
| 79,400 " ..... | 78,800 " ..... | +0.8 |
| 89,370 " ..... | 88,200 " ..... | +1.3 |
| | Average.. | +1.3 |

The results of the preliminary tests were considered satisfactory.

THE 500,000-LB. MACHINE.—The machine adopted consists of a hydraulic press, an intensifier and a triple plunger 1¼ × 2-in. pump. The pump is belt driven, but can be operated by hand. The liquid used is distilled water treated with a lubricating compound. By means of a by-pass

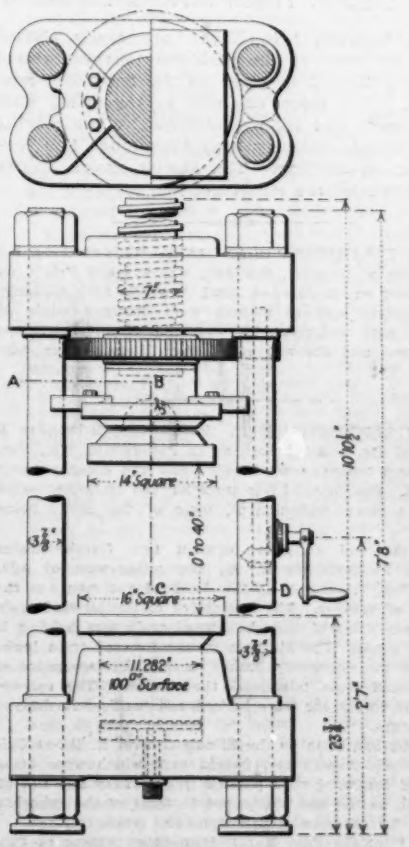



Fig. 2. 500,000-lb. Testing Press.

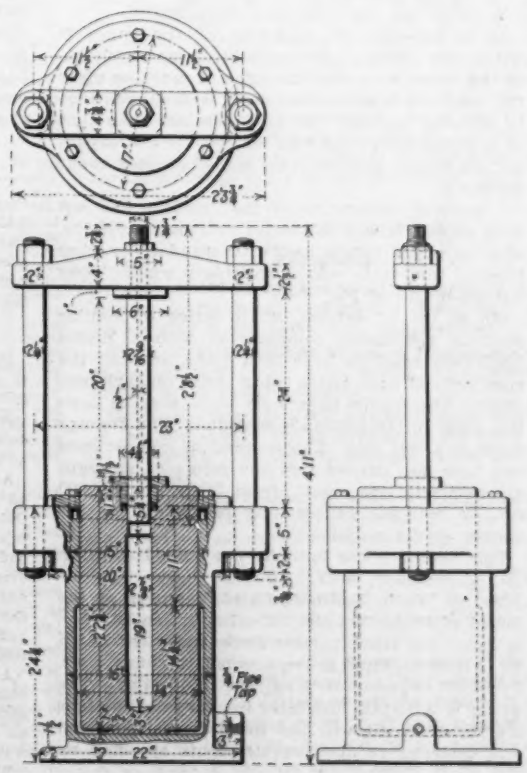



Fig. 3. 13 × 2 9-16 × 20-in. Hydraulic Intensifier.

Built by John Robertson & Co., Brooklyn, N. Y., for 500,000-lb. Testing Outfit.

*Assistant Engineer, Board of Water Supply, 147 Varick St., New York City.

valve placed between the intensifier and the press, the rate of loading is easily controlled independently of the speed of the pump. Duplicate gages were specified, one being ordinarily shut off during operation of the machine, but used at frequent periods as a test gage.

The machine has been in use over a year, and has given satisfactory service.

Features of this machine, which are thought to be improvements over the ordinary type of hydraulic press for testing purposes, are:

(a) The use of an intensifier between the pump and press, thus minimizing shock from the pump's pulsations. In use, the index of the gage moves with very uniform motion, indicating a steady rate of application of load.

(b) The copper lining of the cylinder tending to limit corrosion, and consequently to reduce friction.

(c) The attachment of the cup leather packing to the bottom of the ram instead of placing it in a recess in the cylinder near the top, which is a more usual construction. This arrangement secures the greatest durability of packing, and a long guiding surface for the ram in case eccentrically placed specimens produce a side thrust.

Experience in the operation of this machine has shown the desirability of employing duplicate gages and of not using a large machine for very low-strength specimens. The gages used are graduated to give by direct reading the total pressure on the ram. One adjustment of gages has been required during the use of the machine. A comparison of the gages with a standard test gage, after several months use, gave a maximum error of 2% between 20,000 and 500,000 lbs. Below 20,000 lbs. the error was much larger.

It is believed the accuracy of the gages is within the limits of determinable error of friction in the press, and that this type of machine gives the required degree of accuracy and convenience in concrete testing. Its cost was less than that of a screw-power machine of 150,000 lbs. capacity; its weight and the floor space occupied about the same.

A general calibration of the machine has not been made. It was calibrated to about 12,000 lbs. after nearly a year's use, with standard proving levers. The error was surprisingly small, being but six-tenths of 1%.

By means of several small series of similar concrete specimens, comparisons with a Riehle 100,000-lb. machine have been made, one-half the specimens of each series being tested on each machine. The results invariably show a small positive error in the hydraulic machine. The average error is about 5%. The number of comparisons has been too limited and the range of strength of specimens too small, from 30,000 to 100,000 lbs., to warrant generalizing regarding the accuracy of the machine.

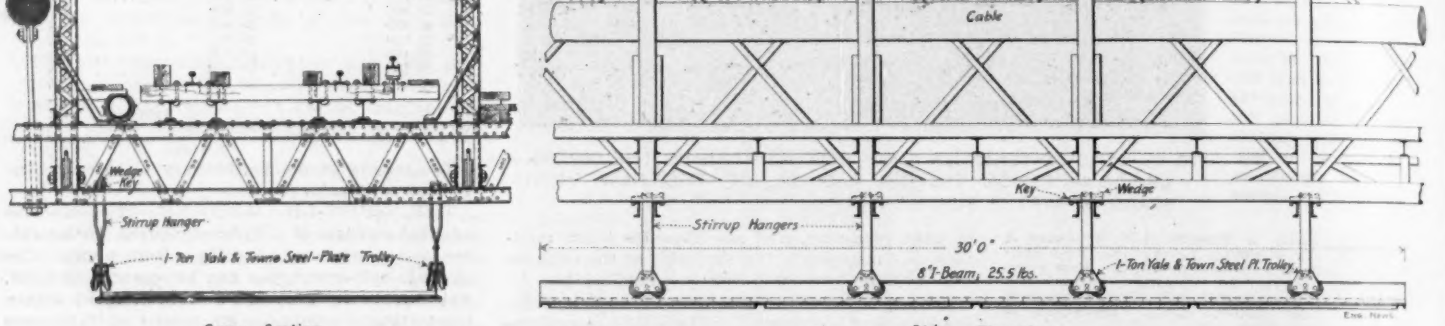
This machine was built by the John Robertson Co., of Brooklyn, N. Y.

Mr. J. Waldo Smith is Chief Engineer of the Board of Water Supply. The Inspection Division is under the Headquarters Department, of which Mr. Alfred D. Flinn is Department Engineer. Mr. Ernst F. Jonson is Engineer Inspector. The writer is Assistant Engineer in charge of the laboratory of the Board, and the machine described was designed to meet requirements specified by him.

## Suspended Traveling Platform for Floor Repairs, Brooklyn Bridge.

Some recent floor repair work on the Brooklyn Bridge, New York City, gave occasion for a rather novel device for suspending the working platform in such a way that the platform could be shifted forward easily and quickly. The former style of suspended platform, used on the infrequent occasions when minor repairs had to be made, was a plain timber staging hung from the floorbeams, which could be shifted only by bringing the platform up through the floor, piecemeal, and rebuilding it at another point. During the past year more extensive repair work was to be undertaken, including the substitution of steel stringers for the wooden stringers of the elevated-railway tracks. As traffic could not be interrupted, it was necessary to do this work from a suspended staging. The primitive staging formerly used was out of the question in a job of this size, and the traveling platform shown in the cut herewith was designed. The traveling feature is attained by Yale & Towne steel-plate trolleys engaging the flanges of an I-beam as a track.

The essential novelty lies in the fact that the common arrangement of fixed track and moving trolleys is reversed, the trolleys being hung from the bridge and the track attached to the platform. The hangers carrying the trolleys are hooked over cross-pieces laid on the floorbeams; a wedge between hanger and cross-piece give a means for adjusting the height of the trolley. These hangers, being light, are easily shifted from the rear of the platform to the forward end and hooked in place on the floorbeam next ahead. The more common arrangement, with fixed track and trolleys attached to the moving part, would obviously have been much less convenient in shifting. The sketch shows clearly the details of the structure.




SUSPENDED TRAVELING PLATFORM USED IN FLOOR REPAIRS, BROOKLYN BRIDGE, NEW YORK CITY.

THE STEAMSHIP "CLAN RANALD" owned by the Clan line of Glasgow, Scotland, was wrecked Feb. 1 off Edithburg on the coast of South Australia near Adelaide. The captain and 45 seamen were drowned while 18 others were rescued. The vessel's displacement was 2,285 tons and she was bound from Mauritius for Adelaide.

TWO STOCK TRAINS on the Chicago, Milwaukee & St. Paul Ry. collided head-on at Powersville, Mo., Feb. 3. Three trainmen were killed and one other severely injured. Four cars of live stock left the track and rolled down a steep embankment, most of the cattle being killed.

A rear end collision between two freight trains on the Pennsylvania R. R., two miles west of Ada, Ohio, Feb. 3, resulted in the death of one man and the injury of another. The locomotive of the forward train had been disabled and the second train was helping it over a grade. The air hose on the forward train broke and set the emergency brakes so that the locomotive of the second train telescoped the caboose. The caboose and one empty car were burned and traffic was delayed four hours.

A suburban train on the Illinois Central R. R., at Chicago, collided with two freight cars which were being shunted backward on a parallel track. They had run off an open switch and overturned in front of the suburban train. The fireman of this train was fatally injured.

The "Chicago Fast Mail," from New Orleans to Chicago, over the Illinois Central R. R., [illegible] into an open switch in the town of Coldwater, Miss., [illegible] every coach but one was overturned. Two persons [illegible] killed and some 15 were seriously hurt. In the [illegible] reports it is claimed that the train was deliberately wrecked by unknown parties.

A SMALL TORNADO swept through the Southern and South Central States in the afternoon of [illegible] 5, blowing down poles, fences, stacks and light [illegible] structures. The rice fields of Arkansas and Louisiana are reported to have been damaged and the loss of [illegible] throughout the whole area is given as somewhat over [illegible].

FILTERED WATER for the whole city of Philadelphia, it is reported, will be available on March 1. On Jan. 13, 60 of the 120 preliminary filters at the Torresdale plant on the Delaware River were put in operation, and it is expected that the others will be ready for use by March 1, thus giving a capacity at this plant of 240,000,000 gals. per day, and a total capacity, including the Belmont and Roxborough filters, of about 300,000,000 gals. per day.

NEW ATLANTIC EASTBOUND RECORDS were made by the "Mauretania," one of the two Cunard turbine steamers, on her first eastbound passage with new propellers. The passage, made over the long course, 2,934 sea miles, was made in 4 days, 20 hrs., 27 mins., beating by 2½ hrs. the best previous record, of the "Lusitania." An average speed of 25.20 knots was maintained, which is the fastest long-distance traveling ever done on the sea. During a single day an average speed of 26.33 knots was attained, that day's run being 605 sea miles (23 hrs. run from noon to noon). This would correspond to a day's run westward (25 hrs.) of about 650.

PANAMA CANAL EXCAVATION during January totaled 2,924,551 cu. yds., a daily average of 116,982 cu. yds. for 25 working days, as against 3,261,673 cu. yds., a daily average of 125,449 cu. yds., for the 26 working days of December. The record for the past two months is as follows:

| Steam shovels: | January. | December. |
|---|---|---|
| Atlantic division | 114,665 | 128,293 |
| Central division | 1,452,953 | 1,527,185 |
| Pacific division | 138,100 | 133,189 |
| Dredging: | | |
| Atlantic division | 573,321 | 679,004 |
| Pacific division | 490,584 | 675,766 |
| Canal prism total | 2,769,632 | 3,143,947 |
| Accessory work outside canal prism: | | |
| By steam shovel | 110,147 | 109,143 |
| By dredging | 44,772 | 8,583 |
| Total excavation | 2,924,551 | 3,261,673 |

The rainfall during January was 4.39 ins. against 5.93 ins. in December.

CANADIANS FOR THE QUEBEC BRIDGE COMMISSION is the demand of some engineering circles of the Dominion. According to the Toronto "Globe," a deputation from the Engineers' Club of Toronto visited Ottawa recently to urge that Canadian engineers be appointed to the Commission which is in charge of rebuilding the Quebec Bridge. They represented that Mr. Fitzmaurice is Irish and Mr. Modjeski, American; as for Mr. Vautelet, the third member, he is a Frenchman by training, though now long resident in Canada.

THE BIG-GUN BATTLESHIP "DELAWARE" was launched by the Newport News Shipbuilding & Drydock Co. at Newport News, Va., on Feb. 6. The "Delaware" was contracted for on Aug. 6, 1907, and the keel was laid on Nov. 11, so that the time of construction until launching was 15 months. The dimensions of the vessel are: L. W. L. length, 510 ft.; breadth, 85 ft. 2 ins.; mean draft, 27 ft.; trial displacement, 20,000 tons. The motive-power is furnished by quadruple-expansion engines, giving a maximum speed of 21 knots. Coal-

bunker capacity of 2,500 tons is provided, and in addition there is room for stowing oil fuel. The armament of the vessel consists of 10 12-in. guns, 14 5-in. rapid-fire guns, and lighter arms, besides two torpedo tubes. The contract price is $3,987,000.

Three other vessels of the same type are under construction or soon to be built: the "North Dakota," at the Fore River yards; the "Florida," at the New York navy-yard; and the "Utah," at Camden. The design of this class was worked out in accordance with the recommendations of a special board of naval experts.

CONGRESSIONAL AID FOR DEEPENING THE HUDSON River between Hudson and Waterford, N. Y., is being sought under the leadership of Mr. F. C. Stevens, Superintendent of Public Works of the State of New York. The aim is to obtain a 12-ft. channel 200 ft. in width, in order to form a connection between the eastern end of the new Barge Canal at Waterford and deep water at Hudson. The improvement would involve a new dam and lock at Troy to take the place of the one now in use there.

SURVEYS FOR A LINCOLN MEMORIAL HIGHWAY, to be known as Lincoln Way and to extend from the White House in Washington to the battlefield of Gettysburg, Pa., are proposed by a resolution recently introduced into Congress. The resolution adopted by the Senate is as follows:

That with a view to the construction of suitable memorials to commemorate the public services and character of Abraham Lincoln, which memorial may include a great national highway to be called "The Lincoln Way," from Washington to the battlefield of Gettysburg, in the State of Pennsylvania, the sum of $50,000, or so much thereof as may be necessary, to be expended under the direction of the Secretary of War, is hereby appropriated out of any money in the Treasury not otherwise appropriated, to defray the expenses in making a survey, plans for construction and estimates of cost by engineers of the United States Army for said highway.

THE SUBSTITUTION OF OHIO RIVER WATER for a ground-water supply at Bellevue, Pa., for a few days about the middle of January, 1909, caused a violent bowel disorder which is said to have affected some 4,000 people out of a population of 32,000. The untreated river water was furnished from the 15th to the 17th of the month. The water was supplied by the Ohio Valley Water Co., whose ordinary supply from driven wells on Neville Island, about four miles below Pittsburg, ran short. Dr. J. C. Welch is Secretary of the Bellevue Board of Health. It will be interesting to see whether this outbreak, which came only a week or so after the use of the river water, will be followed in turn by typhoid.

DUMPING GARBAGE ON THE BANKS OF THE Delaware River by the public authorities of Phillipsburg, N. J., cannot be prohibited under the terms of the so-called potable water act of 1899, according to a recent New Jersey court decision. Curiously enough, lack of power on the part of the State Board of Health in this case is due to the fact that the act in question was made inapplicable to cities and towns having sewerage systems when the act became a law. This particular decision has been widely proclaimed as curtailing the power of the State Board of Health to prohibit stream pollution by sewage. The facts are, however, that the 33 orders issued by the New Jersey State Board of Health against stream pollution in various parts of New Jersey are all based on an act of 1900, which revised an act of the former year creating the State Sewerage Commission. This Commission was consolidated last year with the State Board of Health, or rather both the Commission and the Board were abolished and a new State Board of Health was created having the powers and duties of both the old boards. Under the act of 1900, suits brought by the State Board of Health are now pending against Phillipsburg, Sea Bright, Jersey City and West Hoboken to restrain them from discharging untreated sewage into streams. Under other clauses of this same act of 1900, two towns which have built sewers without purification plants since the passage of the act, and which have failed to submit their sewerage plans to the State Sewerage Commission or to the State Board of Health for approval, have been restrained from discharging their untreated sewage into streams. Mr. Harry M. Herbert, M. Am. Soc. C. E., is Chief of the Division of Water Supply and Sewerage of the State Board of Health.

CONTROL OF STREAM POLLUTION, sewage and water purification will be vested in the State Board of Health of Indiana, provided a bill drawn by Representative H. L. McGinnis passes the legislature of that state. It is stated that the approval of the bill by Governor Marshall may be expected, inasmuch as it is in line with general suggestions made in his inaugural address. The bill provides for the investigation by the State Board of Health of complaints of the pollution of public water supplies on the one hand, and, on the other hand, authorizes the Board to investigate impure or dangerous water-supplies. Remedies may be ordered in either case, and if the orders of the Board for improvements in either sewage-disposal methods or water-supply conditions are not obeyed within the time stipulated by the Board, the authorities responsible for the water-supply would be required to appoint a competent person, satisfactory to the Board, to take charge of the plant and operate it to the satisfaction of the Board. In case any order of the Board is not acceptable to water or sewage authorities, the latter would have the privilege of calling for arbitrators, in which event one sanitary engineer would be chosen by the Board and another by the water or sewage authorities, and in case of disagreement these two would select a third engineer. The finding of any two of such a board of engineers would be considered the order of the Board, but would be subject to appeal to the courts of the State. In such an appeal the report of the engineers would be considered *prima facie* evidence of the facts. The expenses of such boards of arbitration would be divided equally between the State Board of Health and the other party to the dispute. The proposed act would make it unlawful to construct any sewer or drain, the discharge from which would injuriously affect any stream or body of water for domestic use, without providing a plant for the purification of the sewage; and the plans for such plants would have to meet the approval of the State Board of Health. Under the proposed act, the cost of sewage-purification plants would be assessed upon property benefited, as is now done in Indiana in the case of sewers under the so-called Barrett Law. Interstate streams are exempt from some of the provisions of the bill. Since the foregoing synopsis of the act was written it has been reported that the lower branch of the legislature has passed the act.

STREAM POLLUTION, WATER AND SEWAGE PURification in Minnesota, will be placed in control of the State Board of Health, if a bill now before the legislature of that state becomes law. The bill provides, first of all, that plans of existing water-supply and sewerage systems, together with a statement of sources of water-supply and places of sewage disposal [outlet points?] must be filed with the State Board of Health within six months of the passage of the act; and further that no other source of water-supply or place of sewage disposal shall be adopted hereafter without a written permit from the Board. Permits must also be obtained for the construction of new and the extension of old water-works and sewerage systems, except that water mains may be extended without such permits. Before granting or refusing permits, the Board must make personal investigation. The Board is also required to investigate written complaints alleging that the discharge of sewage is causing "a public nuisance detrimental to health or comfort, or polluting the source of any public water-supply." The proposed act does not state how these complaints must originate, but a twin section relating to water-supply provides that the board of health, the health officer or any ten electors of any city or village in the state may file with the State Board of Health written complaint stating the belief that a public water-supply is impure or dangerous to health. After investigation of the two kinds of complaints just noted, the State Board of Health may, if in its opinion the facts warrant it, require changes in sewage disposal or water-supply, or the provision of sewage or water-purification plants. A further and important provision of the proposed act is so interesting that we quote it in full as follows:

Whenever the State Board of Health finds upon investigation that any water or sewage-purification works, because of incompetent supervision or inefficient operation, are not producing an effluent as pure as might reasonably be obtained from such plant, and by reason of which any public water-supply has become dangerous to health, or any stream or body of water has become offensively polluted or has become a public nuisance, said Board shall issue an order to the officer, board or department of any city, village, corporation or person having charge of or owning such plant, to secure an effluent as pure as might reasonably be expected from such plant, and satisfactory to said Board; and if such officer, board or department of any city, village or corporation fails for a period of five days after receiving such order to secure such an effluent, the State Board of Health may order such officer, board or department, or owner of such plant, to appoint within two days, and pay the salary of, a competent person approved by the State Board of Health to take charge of and operate such works so as to secure the results demanded by said Board.

In case any order of the State Board of Health relating to matters already outlined "is not acceptable to any municipality, corporation or owner," the act provides for appeal to referees, consisting of "two reputable and experienced sanitary engineers," one to be chosen by the municipality, corporation or owner and the other chosen by the State Board of Health. The usual provision is made for a third referee in case of disagreement. The vote of any two of the referees "shall be final and binding." Moreover, these referees would have "power to affirm, modify or reject the order of the State Board of Health submitted to them." The fees and expenses of such referee engineers would be equally divided between the two sides. The act makes it the duty of municipal authorities receiving such orders to provide funds for the purpose stated, which funds shall not be usable for any other purpose and shall not require approval by popular vote—provided, however, that bonds issued for the purposes named shall not be in excess of 3% of the total taxable assessed value of the municipality. Any person who for a period of 30 days fails or refuses to execute orders of the State Board of Health issued under the provisions of the act would "become personally liable for such default," and upon conviction thereof would be subject to a fine of $500. It is made the duty of the respective county attorneys of the state to prosecute for violations of the act, and fines collected as a result of such prosecutions are paid into the respective county treasuries.

A WATER DISTRICT for San Francisco, Oakland and vicinity is provided for in a bill prepared for introduction in the California Legislature. The bill is the work of a committee which includes Mayors Taylor and Mott, of San Francisco and Oakland, respectively, City Attorney J. E. McElroy, of Oakland, two assistant city attorneys of San Francisco, Mr. H. A. Mason on behalf of the San Francisco Board of Supervisors, and Mr. J. H. Dockweiler, M. Am. Soc. C. E. Mr. Dockweiler has for five years past been consulting engineer to the city attorney of San Francisco in connection with the litigation with the Spring Valley Water Co., and for three years has been consulting engineer to the city attorney of Oakland. The bill proposes a representative commission which, on authorization of two-thirds of the electors in the water district, will have power to issue bonds for and to develop the water supply of the various municipalities in the district, but which would have no jurisdiction whatever over the respective distribution systems. Water would be sold by the district to the municipalities at cost, with the understanding that the cost should include interest, sinking fund and depreciation charges, as well as operating expenses. The bill would enable the cities of San Francisco, Oakland, Alameda and Berkeley to purchase the property of the water companies now supplying those cities. The limits of the district, it appears, would be larger than indicated by the cities just named, for it is stated that the district would include Leland Stanford, Jr., University as well as the University of California. San Francisco is now supplied by the Spring Valley Water Co., and Oakland, Alameda and Berkeley by the People's Water Co. As to the need of developing additional water, the statement issued by the committee may be quoted as follows:

The present supply of water to San Francisco is about 33,000,000 gals. daily and the capacity of the present works is 35,000,000 gals. daily, and the consumption is increasing yearly about 1,500,000 gals. daily. The present supply of the People's Water Co. is about 17,000,000 gals. daily, which is taxing the capacity of the works. Oakland will face a water famine at its present rate of consumption in about one year and San Francisco in about three years.

According to the statement, the present supply for Oakland, Alameda and Berkeley could be increased from relatively nearby sources to the extent of about 20,000,000 gals. per day at a cost of about $8,000,000, while the Spring Valley Water Co. could add 30,000,000 gals. per day to its supply at a cost of $11,000,000—the last-named additional supply being from Alameda Creek sources. It is said that the population of the district is now growing at the rate of "at least 75,000 per annum"; that existing "works are not being enlarged to take care of this increasing population"; and that at least six years would be required to bring in water from the Hetch-Hetchy Valley as now proposed by San Francisco.

## Personals.

Mr. T. A. Wilson, Superintendent of the South Texas division of the Missouri, Kansas & Texas Ry., with headquarters at Smithville, Tex., has resigned.

Mr. T. E. Risler has been appointed Division Engineer of the Lehigh Valley R. R. at Auburn, N. Y., succeeding Mr. T. K. Bennett, resigned.

Mr. H. M. Taylor, formerly Assistant General Manager of the Inter-Oceanic Ry. of Mexico, has succeeded Mr. J. N. Galbraith as General Manager of the Mexican Central Ry.

Mr. James R. Stewart, formerly Assistant Engineer of the Pennsylvania R. R., at Chicago, Ill., has opened an office as an architect and consulting engineer in Norwood, Ohio.

Mr. Robert McCulloch, Vice-President and General Manager of the United Railways Co., of St. Louis, has been chosen to succeed Mr. John I. Beggs, Assoc. Am. Inst. E. E., as President.

Mr. J. C. Dailey, General Superintendent of the International & Great Northern R. R., has resigned to become General Superintendent of the Denver & Rio Grande R. R., in place of Mr. E. Stenger, resigned.

Mr. C. G. Young, M. Am. Inst. E. E., formerly with J. G. White & Co., has opened offices at 60 Wall St.,

New York City, as a consulting and constructing engineer.

Mr. A. J. Hines, M. Am. Soc. C. E., Assistant Chief Engineer of the New York, Chicago & St. Louis R. R., has been placed in charge of all work involved in elimination of grade crossings in Cleveland, Ohio, with the title of Engineer of Grade Elimination.

Mr. L. C. Fritch, M. Am. Soc. C. E., Assistant to the President of the Illinois Central Ry., has been appointed Consulting Engineer of that road, and will have charge of the investigations as to the best system of introducing electric traction on the Chicago terminal system.

Mr. F. A. Molitor, M. Am. Soc. C. E., who was formerly employed to conduct the location, construction and operation of the railway line built under Government subsidy in the Philippine Islands, has opened offices as a civil and consulting engineer at 79 Wall St., New York City. He will make a specialty of railway work.

Among those who will speak at the annual dinner of the alumni of the Stevens Institute of Technology, to be held in New York City, Feb. 19, are the following: Mr. Alex. C. Humphreys, M. Am. Soc. M. E., President of Stevens Institute; Mr. Alfred Noble, Past-President, Am. Soc. C. E.; Mr. H. G. Prout, M. Am. Soc. C. E.; Mr. John A. Bensel, M. Am. Soc. C E

Mr. Edgar B. Thompson, Assistant Superintendent of Motive Power and Machinery of the Chicago & Northwestern Ry., has become Superintendent of Motive Power and Machinery of the Chicago, St. Paul, Minneapolis & Omaha Ry., succeeding Mr. John J. Ellis, who has been retired for age. Mr. Thompson will be succeeded by Mr. E. W. Pratt, Division Master Mechanic of the Chicago & Northwestern at Missouri Valley, Iowa.

Mr. D. C. Henny, M. Am. Soc. C. E., Supervising Engineer in the U. S. Reclamation Service, has resigned to take up private work, but will act from time to time as consulting engineer in the Reclamation Service. Mr. E. G. Hopson, M. Am. Soc. C. E., who has been in joint charge with Mr. Henny of the northwestern district, comprising the states of Washington, Oregon, Nevada and practically all of California, will retain supervision of Oregon, Nevada and California. Mr. C. H. Swigart, now in charge of the Tieton project in Washington, will have supervision over that entire state.

## Obituary.

George M. Magee, of the firm Magee & Rowe, architects, died at his home in Wenham, Mass., Feb. 7. He was a graduate of the Massachusetts Institute of Technology, class of 1904.

William L. Purcell, President of the Coahuila & Zacatecas Ry. since 1897, died Feb. 5 at San Antonio, Tex. He was 64 years old. Mr. Purcell came to America from Limerick, Ireland, in 1861, making his first home at Matamoras, Mexico.

Thomas Oliver, mechanical engineer and the inventor of the Oliver typewriter, died of heart disease in a railway station at Chicago, Feb. 9. It is stated that he was on his way to Arkansas to conduct tests of a recent invention for picking cotton.

Charles P. Adams, Superintendent of Telegraphs of the Southern Ry., died at his home in Washington, D. C., Feb. 9, after a cerebral hemorrhage. He was 50 years old and nearly all his life had been spent in railway telegraph service.

Charles H. Dutton, whose death was announced in this column Jan. 28, was not, as erroneously stated in that issue, an associate member of the American Society of Civil Engineers. Mr. Charles H. Dutton, Assoc. M. Am. Soc. C. E., is still living at his home in Chelmsford Center, Mass.

Levi Chapman Lathrop, President of the Bessie Ferro-Silicon Co. and the Columbus & Hocking Clay Construction Co. and Vice-President of the Columbus & Hocking Coal & Iron Co., died Feb. 2 at his home in New York City. Mr. Lathrop was born at Syracuse, N. Y., in 1844.

Thomas Lowry, President of the Minneapolis, St. Paul & Sault Ste. Marie Ry. and of the Twin City Rapid Transit Co., died Feb. 4 at his home in Minneapolis. Mr. Lowry was born in Logan Co., Ill., in 1843 and was educated at Lombard University, Galesburg, Ill. He became President of the Minneapolis, St. Paul & Sault Ste. Marie in 1889.

Arthur G. Yates, President of the Buffalo, Rochester & Pittsburg R. R., died at the Waldorf-Astoria Hotel, New York City, Feb. 9, after a cerebral hemorrhage. He was born in East Waverly, N. Y., Dec. 18, 1843, and in 1865 was associated with the Anthracite Coal Association of Rochester. In 1867 he entered the coal trade for himself and in 1876 formed the coal-mining firm of Bell, Lewis & Yates. This firm sold its interests, in 1896, to the Buffalo, Rochester & Pittsburg R. R., of which Mr. Yates was president. He was also a director in several coal and railroad companies.

Jose F. de Navarro, who was the promoter of the Metropolitan Ry., the first elevated line in New York, and the founder of the Ingersoll Rock Drill Co., died Feb. 3 at his home in New York City. He was born in San Sebastian, Spain, 86 years ago and was educated at the Spanish Naval Academy, where he graduated at the age of 15 years. Soon after graduating, he came to Cuba and subsequently became an instructor in mathematics and astronomy at the University of Havana. At the age of 19 he came to Philadelphia, where he taught Spanish and French, and he later became a teacher at the Jesuit College in Baltimore. He returned to Cuba in 1844 and organized a mercantile firm, but soon came back to the United States to engage in business in New York City. His name became widely known a generation ago through his building the Navarro Apartments, on Central Park South, the first high-class modern apartment house. Mr. de Navarro was married in 1857 to Miss Helen A. Dykers, who with two sons survives him. He was a director of the Equitable Life Assurance Society and of the Atlas Portland Cement Co.

Joseph M. Graham, M. Am. Soc. C. E., Vice-President of the New York, Susquehanna & Western R. R. and Fourth Vice-President of the Erie R. R., died Feb. 3 at his home in New York City. Mr. Graham was born at Crawfordville, Ind., in 1850 and was educated at the State University of Kentucky from which he eventually received the degree of Doctor of Engineering. He entered railway service in 1873 and was successively associated with the Grayville & Mattoon Ry., the Bedford, Springville, Owensburg & Bloomfield Ry., the Danville, Olney & Ohio River Ry., and the Chicago, Texas & Mexican Central Ry., as Assistant Engineer or Chief Engineer. He next became General Superintendent of the Danville, Olney & Ohio River in 1882, and from 1883 to 1891 was consecutively Division Superintendent, General Manager and Assistant General Superintendent of roads in the northern Pacific system. In September, 1891, he entered the service of the Baltimore & Ohio R. R. as Superintendent of the Ohio and Midland divisions and in 1898 became General Superintendent of the Trans-Ohio divisions. In the following year he was made Chief Engineer of the Baltimore & Ohio and remained in this position until 1904, when he became Fourth Vice-President of the Erie.

## Engineering Societies.

### COMING MEETINGS.

NEW ENGLAND GAS ASSOCIATION.
Feb. 17-18. Annual meeting at Boston, Mass. Secy., N. W. Gifford, East Boston Gas Co., East Boston, Mass.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 23. Annual meeting at New Haven, Conn. Secy., R. W. Raymond, 29 West 39th St., New York City.

NORTHWESTERN CEMENT PRODUCTS ASSOCIATION.
March 2-4. Annual convention at Minneapolis, Minn. Secy., J. C. Van Doorn, 836 Security Bank Bldg., Minneapolis, Minn.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.
March 16-18. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago.

WESTERN SOCIETY OF ENGINEERS.—At the meeting held in the society's rooms in Chicago, on Feb. 3, an interesting paper on "Water Storage in Elevated Tanks and Stand-Pipes" was read by Mr. Horace E. Horton. The stand-pipe system for water-supply dates back some 40 years to Mr. Cook, of Toledo, O., who originated a system of water-works for small towns in which a moderate-sized engine and an enlarged stand-pipe were used, thus avoiding continuous pumping. With an elevation of 100 ft., it cost twice as much to store water in a stand-pipe as it does to store it in an elevated tank; and three and four times as much when the average elevation is 150 ft. and 200 ft. The bottom of the tank may be flat (which is expensive), conical or hemispherical, and the legs of the tower may be attached to a circular girder or directly to the tank. To ensure water-tight work, a careful study should be made of the joints, so that the rivets will not go through a large number of plates and the calking edges will be easily accessible. Sprinkler tanks (in which the water stands idle) must be heated in cold weather.

The use of this system of water storage effects a material economy in the cost of operating water-works systems. At Paris, Ill., after 20 years of the direct-pressure system, an elevated tank was installed in 1895, and the operating expense was thereby reduced 40%. At Galion, O., the reduction effected in the same way was 33%. Failures in stand-pipes have been somewhat numerous, and in most of these cases fairly high unit stresses have been involved. Elevated tanks and towers have a better record. As to reinforced-concrete stand-pipes, these require as much steel as steel structures of the same capacity. In regard to stand-pipe failures, Mr. Horton referred to the bottle-shaped steel stand-pipes built some years ago. The paper was illustrated by a large number of views of elevated water tanks and towers of various designs and presenting various special features. In some of these, the tower carries a sprinkler tank of a small service tank below the main tank. Most of the towers had inclined legs, ranging from three to eight in number. In one case, they were curved. One tower, at a factory, had vertical legs for the lower portion, then inclined inward at the top to carry the tank. One peculiar design had the legs attached directly to the tank shell, and with no surrounding girder, platform or stairway.

In the discussion, Mr. T. W. Snow referred to the great amount of work done by Mr. Horton in this line, and to the number of water tanks built by him. The failures of stand-pipes have been due largely to ice formation, as shown by the investigations of Prof. W. D. Pence. No such failures have occurred with elevated tanks. Where lagging is used, in climates, an air space of 2 ins. to 5 ins. should be left around the tank. Mr. White spoke of a case of ice formation in an elevated tank; its weight was estimated at 20 tons, but no damage resulted. Mr. Nagle and Mr. Storey referred to the question of deterioration of steel in tanks, in reply to which Mr. Horton referred to some old structures still in use. Mr. W. W. Curtis referred to designs for an elevated tank on a stone tower for Cedar Rapids, Ia., made by him in 1887, when associated with Mr. C. F. Loweth. The bids for the tower were so high that they were rejected, and he afterwards designed a steel tower which was one of the first built in this country.

As to reinforced-concrete tanks, Mr. C. P. Burdick stated that at first sight this use of concrete did not seem promising as the stress is all tensile. Thus the amount of steel reinforcement to take this stress must be practically equal to that in the plates of a steel structure. But while the plates cost about 5 cts. to 6 cts. per lb., the reinforcing steel costs only about half as much, the balance being sufficient for the concrete. In some of these structures the cost has been not materially different from that of steel structures of the same size. This use of reinforced concrete, however, is quite new (being within the past five years), and it may be developed in the future.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The next monthly meeting will be held on Feb. 23, the fourth Tuesday of the month, instead of the second Tuesday, as usual. The subject of the evening's discussion will be Safety Valves, introduced by a brief paper by Mr. Frederic M. Whyte, General Mechanical Engineer of the New York Central lines. Mr. Whyte will discuss the principles of the application of safety valves to steam boilers with special reference to locomotive practice, including questions of design and construction, and the requirements and limitations of valves. His paper will be followed by a general discussion covering marine and stationary practice and conditions existing in connection with low-pressure heating boilers.

ENGINEERS CLUB OF BALTIMORE.—At the regular meeting held Feb. 6, a paper was presented on "Engineering Work in Costa Rica," by Mr. Wm. D. Janney, M. Am. Soc. C. E.

NEW YORK STATE WATERWAYS ASSOCIATION.—A permanent organization under the above name was effected at the conference held in Brooklyn, N. Y., Jan. 21-22, announced in our issue of Jan. 14, and officers were elected as follows: President, Robert J. MacFarland, Brooklyn; Vice-Presidents, Henry W. Hill, John D. Kernan, Edward M. Grout; Secretary, Frank S. Gardner, New York; Treasurer, Frank S. Witherbee, Port Henry.

AMERICAN PEAT SOCIETY.—A meeting will be held at the Chemists' Club, 108 West 55th St., New York City, at 7.30 p. m., on Saturday, Feb. 13, to form a New York section. Prof. F. R. Stevens, of the New York Farmers' Institute, will speak on the development of inundated lands in that state. Prof. C. A. Davis, of Ann Arbor, Mich., will discuss the peat resources of the country. There will be a paper by Dr. Otto Zwingenberger, of New York City, on peat gas and coke and one on peat fertilizers by Mr. Herbert Philipp.

AMERICAN SOCIETY OF HUNGARIAN ENGINEERS AND ARCHITECTS.—The Hungarian engineers and architects in this country have organized this society and plan to hold monthly meetings. The officers are: President, A. Henry Pickler, M. E., M. Am. Inst. E. E., of the Crocker-Wheeler Co., Ampere, N. J.; Vice-President, Karoly Z. Horvay, of the Brooklyn Building Bureau of the Board of Education; Secretary, Zoltan De Nemeth, M. E., and Treasurer, Sander Oesterreicher, M. E., Assoc. Am. Inst. E. E. These officers are located in and about New York City.

WISCONSIN SOCIETY OF ENGINEERS.—It is proposed by 40 or more engineers of the state of Wisconsin, representing cities, public utilities, colleges and manufacturing plants, to organize a state society along the same lines as those which are now in existence in Illinois, Indiana and other states.

The first meeting is to be held in Madison in the Engineering Building of the University on Feb. 24-25. Prof. F. E. Turneaure, Assoc. M. Am. Soc. C. E., Dean of the College of Engineering, is chairman of the program committee and W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis., is secretary.

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